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apc

Dec 2017
Issue 448

YOUR EXPERT GUIDE TO TODAY'S TECH

AY'S BEST PGRADES OVERED

VEAL THE BEST-VALUE RTS FOR ALMOST ANY T, FROM CPUs & GPUs Os, MOTHERBOARDS EAPS MORE

LITERATE CRAPWARE

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- → EFFECTIVELY MANAGE YOUR iPHONE'S STORAGE

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- → FAMILY-SECURITY ROUTERS: PROTECT YOUR HOUSEHOLD
- → WTF: WE TEST A *NON-GAMING* MECHANICAL KEYBOARD

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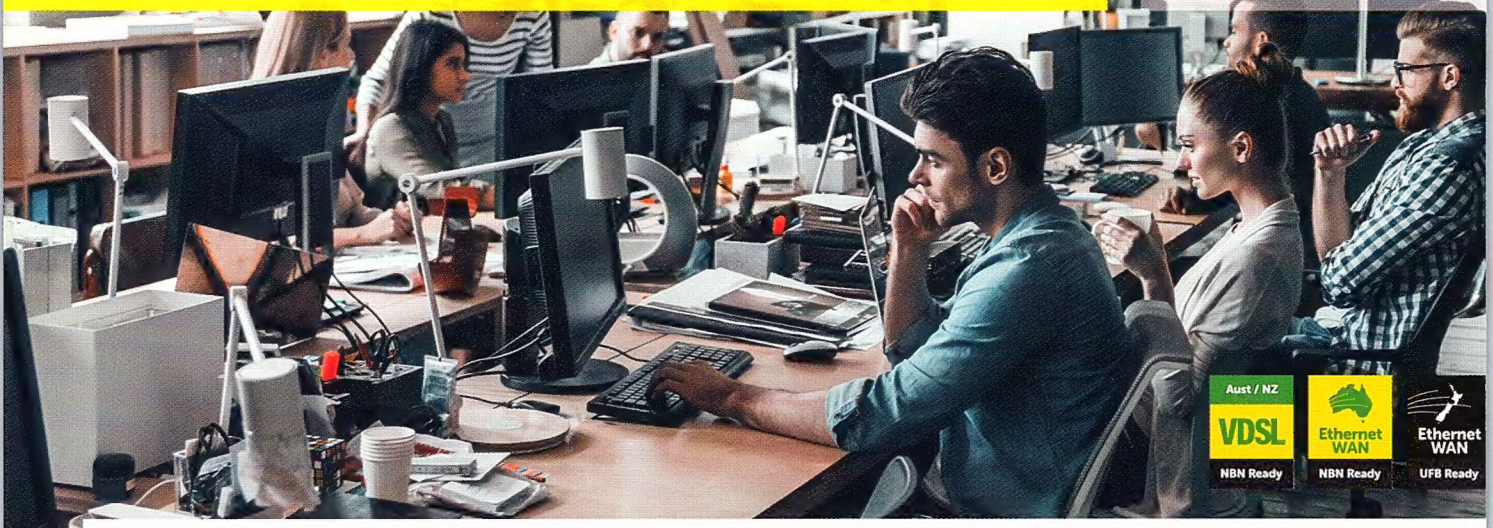


apc RECOMMENDS

TAIWAN EXCELLENCE 2015

32x VPN

Vigor2860 Series

Multi-WAN VDSL2/ADSL2+ & Gigabit Ethernet WAN router with Security Firewall and 32 x VPN & 16 x SSL-VPN tunnels

- Multi-WAN with VDSL2/ADSL2+, Gigabit Ethernet WAN and USB ports for 3G/4G dongles
- VDSL2 vectoring
- 4G LTE SIM card slot (L model)
- 6 x Gigabit Ethernet LAN ports with multiple subnets and 50,000 NAT sessions
- 32 x VPN & 16 x SSL-VPN tunnels with Central VPN Management
- 2 x USB ports for 3G/4G USB modems, network printer, storage and USB thermometer*
- Built-in object-oriented Firewall
- IPv6 & IPv4
- 802.11ac (ac model)
- 802.11n (n model)
- VoIP (2 x FXS and 1 x FXO Line Port) for (V mod
- Works with VigorACS SI management system
- Central AP Management (up to 20 Access Points
- Central Switch Management (up to 10 Switches)
- Smart Monitor Traffic Analyzer (up to 30 nodes)

** Vigor2860L/Ln only has one USB port.*

Vigor2760 Series

VDSL2/ADSL2+ & Gigabit Ethernet WAN router with Security Firewall, and 2 x VPN tunnels including SSL-VPN tunnels

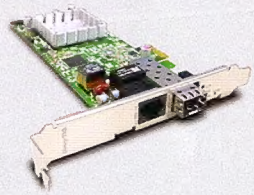
2x VPN

TAIWAN EXCELLENCE 2015

- 1 x VDSL2/ADSL2+ WAN port
- 1 x Selectable Gigabit Ethernet WAN/LAN port
- 3 x Gigabit Ethernet LAN ports
- VDSL2 vectoring
- 2 x USB ports for 3G/4G LTE mobile broadband access, USB printer and storage
- 2 x VPN tunnels including 2 x SSL-VPN tunnels
- Built-in object-oriented firewall
- IPv6 & IPv4
- 802.11n Wi-Fi (n model)
- VoIP (V model)
- Works with VigorACS SI management system

VigorNIC 132F

VDSL2/ADSL2+ PCI Express NIC with Security Firewall, and SFP secondary WAN port



- 1 x VDSL2/ADSL2+ WAN port
- 1 x SFP port for optic fibre or UTP interface module
- VDSL2 vectoring
- Bridging for VDSL2 and ADSL2+
- Object-oriented Firewall
- IPv6 & IPv4
- Support Windows 8, Windows 10 & Ubuntu
- Multi-PVC for triple-play applicatio
- VigorACS SI management system

Vigor130

VDSL2/ADSL2+ modem/router

TAIWAN EXCELLENCE 2014

- 1 x VDSL2/ADSL2+ WAN port
- 1 x Gigabit Ethernet LAN port
- VDSL2 vectoring
- Bridging for VDSL2 and ADSL2+
- Built-in object oriented firewall
- IPv6 & IPv4
- Works with VigorACS SI manage-ment system

i-LAN TECHNOLOGY

i-LAN Technology Pty Ltd trading as DrayTek Aust & NZ

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FIPP

The Wi-Fi security apocalypse

The core security system used by Wi-Fi has been cracked. *APC*'s editor explains how to protect yourself.

Unless you've been living in a doomsday bunker, you've probably already heard about KRACK, the new Wi-Fi exploit that was revealed in mid-October, affecting billions of computing devices worldwide.

You can read more about KRACK on page 8, but given its widespread nature, I'm commandeering this month's ed column to run down what the actual threat to users is and, more importantly, what you can do to protect yourself.

KRACK essentially makes WPA2 – the main encryption protocol used to secure Wi-Fi – useless. So if it's exploited, it can let nefarious hackers into your network to sniff your traffic, putting passwords, credit card info or other sensitive information at risk of being stolen.

The 'good' news with KRACK is that it can be patched from either end, so if either your client device or your router is fixed, you're golden.

So, how to do obtain the necessary patches? Well, if you primarily use Wi-Fi at home and the office, the best place to start is with a router firmware update (if one's available) which will protect all the devices across that network. However, chances are, it'll take many months for firmware updates to be created for all the affected routers. So if there isn't one on offer yet, then you need to get your client devices – PCs, laptops, tablets, smartphones and IoT gear – updated instead.

Microsoft had already rolled out a Windows 10 patch for KRACK at the time we went to print, and Apple had beta Mac fixes that it was hoping to release by the beginning of November, so from a PC/laptop perspective, as long as you have the latest OS and system updates installed you should be OK.

What about mobile operating systems? Well, it's been fixed in iOS 11, and the first fixes for Android should arrive for Pixel owners on November 6th, after which it's up to third-party phone-makers to patch for their handsets and tablets which, if you're familiar with Android updates, could take anywhere from weeks to months to perhaps (sadly) never.

More broadly, unless your phone and/or laptop has been patched, we'd advise staying off public Wi-Fi until they're updated, just to be safe. And regardless, you should always use a VPN on any public network, period, even if it does have security.

With potentially hundreds of thousands of products that'll need patching, KRACK isn't a problem that's going to get fixed overnight, but with a bit of care and caution you can already protect many of your devices. ■

DAN GARDINER
EDITOR-IN-CHIEF
dan.gardiner@futurenet.com

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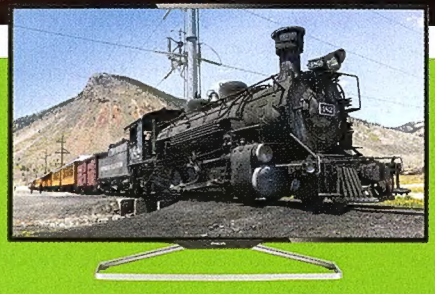

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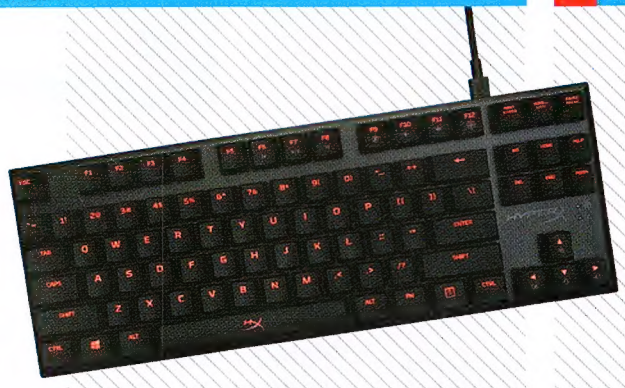

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» HOW TO DOWNLOAD YOUR FREE FULL-VERSION PROGRAMS

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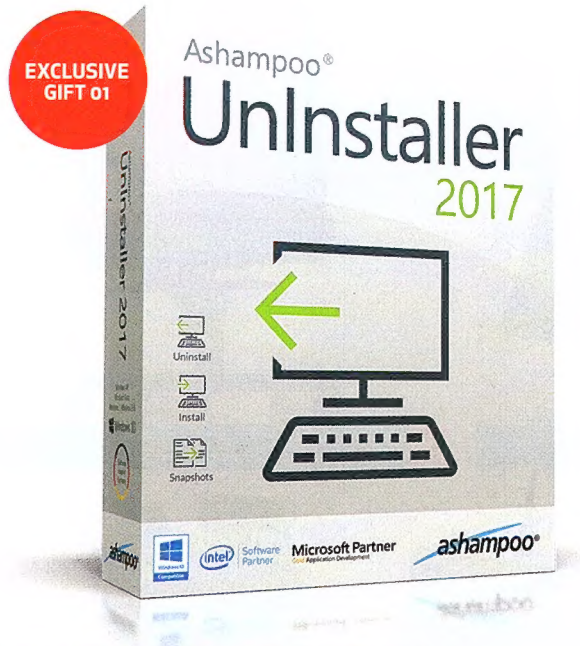

REMOVE UNWANTED SOFTWARE THOROUGHLY

Make sure you're clear with Ashampoo Uninstaller 2017

FULL VERSION REQUIRES ONLINE REGISTRATION.

Ashampoo UnInstaller 2017 removes software completely without any leftover files, even in the case of nested setups. The program meticulously logs new installations to record any modifications to your system. This allows users to uninstall unwanted programs that were installed during normal installations without their knowing. These logs even allow users to uninstall several applications in a row.

DOWNLOAD LINK: www.ashampoo.com/lpa/apc

MAKE SURE YOUR PC WORKS FOR YOU

Cleanse your PC of gunk with Abelssoft PC Fresh

FULL VERSION WORTH $30.

Windows does what it pleases — and that's usually far too much. PC Fresh 2016 cuts the fat off, ending unnecessary Windows services, pruning startup programs and resolving system slowdowns. Additionally, the software finds lost application serial numbers hidden on the system and allows the user to customise various aspects of Windows. The new 2016 version of PC Fresh includes, for the first time, a manager for easily assigning file associations (for instance, opening .txt files with WordPad).

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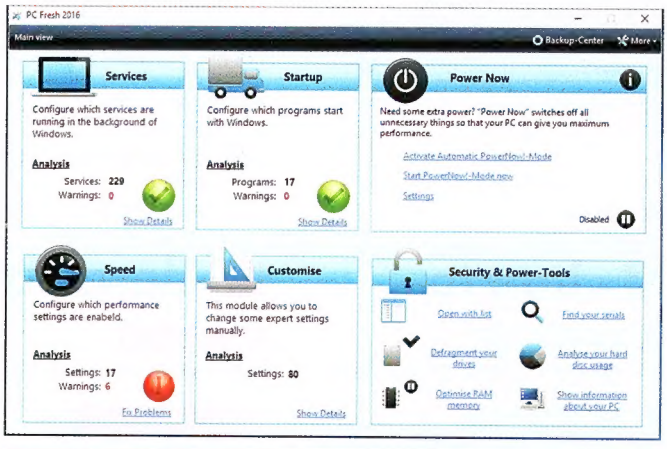

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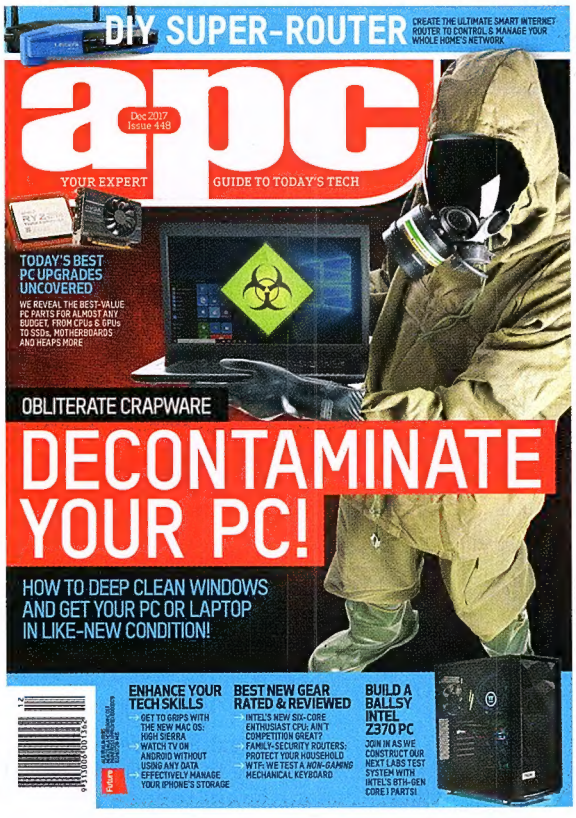
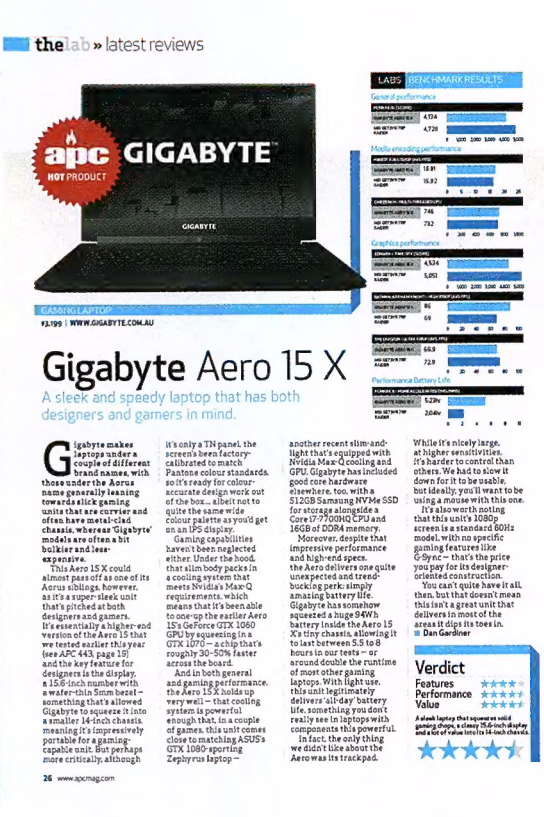




Inside APC

Find out all about *APC*'s editorial policies, test practices, how to read the benchmark results and more.

APC is Australia's oldest consumer technology magazine – having been consistently in print for over 35 years, since our first issue way back in May 1980 – and we take that heritage and responsibility very seriously. While our focus is obviously on the personal computer – it's in our name, after all – the very definition of the PC has changed and shifted markedly since the early 1980s. As such, we touch on many other areas of tech too, from smartphones and apps to peripherals, accessories, online services and beyond. We have two main goals: to track down the best of modern tech and also to help our readers make the most of it.

We're also an open church in terms of platforms. We know most people aren't wed to a single brand's products and use a variety of devices. And like you, *APC*'s journalists want to know what's good in tech – no matter what platform it resides on.

INDEPENDENT REVIEWS

Championing technology doesn't mean we're unrelenting yes-men, however, and *APC* aims to be as objective as possible in all our coverage. That means identifying the best products from multiple perspectives – the best performance, best value and best features and, ideally, the products that offer the best mix of these three.

As a matter of policy, reviews published in *APC* are not shared with product-makers prior to print. We will contact vendors under certain conditions; for example, if we have a problem testing a product that seems to indicate it may be faulty, or to invite a vendor to clarify how a particular feature works. If an *APC* reviewer has any potential conflicts of interest involving a brand, the review will always be assigned to another writer.

LABS TESTING

Despite being a small magazine with limited resources, *APC* still still strives to conduct the most rigorous, objective scientific tests and benchmarks we can so as to make our reviews as unbiased as possible. We use a variety of tools and programs for this, including many freely available benchmark suites for assessing media encoding, general system performance, gaming and battery life.

In most cases, for the benchmark results published in *APC*, you can assume that higher is better. There are certain tests that deviate from this rule and where the opposite is true; in those cases, we've flagged the results with a note explaining as such.

We use both tables and graphs for displaying results; the latter are our preference due to their ease-of-readability, but tables are more compact, so we use these in cases where thoroughness is preferred.

technotes

» NEED TO KNOW

Apple co-founder Steve Wozniak sets up free 'Woz U' coding school

DID THIS APPLE FALL FAR FROM THE TREE?

Having helped revolutionise the tech world alongside Steve Jobs more than three decades ago, Steve Wozniak, Apple's co-founder, has now launched Woz U, an online coding school that focuses on training both students and businesses. The course will concentrate on software development and support specialists first, with data science, mobile development and cybersecurity to follow in the future. At some point, Wozniak hopes to set up physical schools in 30 cities around the world. SS

500 local businesses ready to sell on Amazon Australia's online marketplace

G'DAY, AUSTRALIA!

Global online retailer Amazon has revealed that 500 Australian businesses have already registered to sell on its online marketplace. At the time of writing, Amazon is preparing to educate these retailers on how best to make use of its platform. The company set up its first Aussie warehouse in eastern Melbourne back in July, but as yet there is no news on a date for start of operations. SS

Germany passes legislation to combat online hate speech

BUSINESSES TO COP HEFTY FINES.

Germany is taking a stand against the spread of online hate and other criminal material by passing legislation that requires social media sites operating in the country to take down "obviously illegal" posts or cough up fines of up to €50m. Businesses with more than 2 million German users will have 24 hours to comply, but larger companies, like Facebook, Google and Twitter, will be given seven days to file a report. Critics say this "raises concerns about freedom of expression". SS

Main Wi-Fi security protocol totally compromised by new KRACK attack

Time to patch all the things, people.

WPA2, or Wi-Fi Protected Access 2, has been the standard security protocol for keeping our wireless networks safe for years. That safety net, we were informed, was just an illusion, thanks to one expert's discovery of a vulnerability on the WPA2 four-way handshake security protocol. Mathy Vanhoef has dubbed the exploit KRACK – Key Reinstallation Attack – and it's found in practically every Wi-Fi device used today.

Once this knowledge was made public, US-CERT (Computer Emergency Readiness Team) issued a global warning, saying, "The impact of exploiting these vulnerabilities includes decryption, packet replay, TCP connection hijacking, HTTP content injection, and others," meaning connections could be prone to simple eavesdropping to a full-blown hijack.

Fortunately, many large tech companies have already started patching up the KRACK. Microsoft was the first to send out security updates to fix the problem in Windows, followed soon after by Apple, with Google currently addressing the issue in Android. In the meantime, Wi-Fi Alliance, the non-profit organisation that certifies devices for Wi-Fi security, has promised to start testing for this exploit as part of its standard program. **Sharmishta Sarkar**

State and federal governments agree on national facial recognition database

ALTHOUGH IT DEFINITELY ISN'T MASS SURVEILLANCE...

After a special meeting early in October, Prime Minister Malcolm Turnbull announced that current passport and driver's licence photo data would be merged into a single national database. This data will ideally be used to speed up the identity verification process, vastly shortening the current seven-day waiting period that Federal Police are subject to when identifying a person of interest.

In defending the amalgamation against accusations of mass surveillance, the PM stated that "these photos have been available to law enforcement agencies for many years [...] what we've not been doing is accessing them in a modern, 21st century way". He also ensured that this database wouldn't overstep its boundaries and start incorporating CCTV footage, but instead use it as an external reference. Some state and territory leaders are cautious about the agreement, notably ACT Chief Minister Andrew Barr who has signed up on the condition that it doesn't breach the territory's own Human Rights Acts.

The Government's intention is to have the capabilities up and running by the time the 2018 Commonwealth Games rolls around. **Harry Domanski**

Microsoft finally admits that Windows Phone is dead

ALTHOUGH MOST FANS HAVE LIKELY MOURNED AND MOVED ON BY NOW.

Via a series of tweets, a Microsoft representative announced that the company would no longer be building new features or hardware for the Windows Phone platform, although owners of current handsets will continue to see support in the way of security updates and bug fixes. Microsoft cited the low volume of users and the resulting lack of investment as the primary issue for ending development. **HD**

Even more sites discovered to be secretly mining cryptocurrency

HERE'S HOW YOU CAN STOP THEM.

After it was discovered in early October that The Pirate Bay was surreptitiously using visitors' CPUs to mine cryptocurrency, several other websites have been found to be using the same trick. Along with a host of shady websites (for porn, torrents and so on), US fact-checking website Politifact also found it was unknowingly running a miner, although the offending code has since been removed. To prevent your CPU from being exploited in this way, make sure you have an up-to-date ad blocker installed in your browser. **HD**

Every single Yahoo account was hacked in 2013

YEP, ALL 3 BILLION OF 'EM.

We learned late last year that a security breach from 2013 affected an estimated 1 billion Yahoo account holders. The mail-serving company has since announced that every single one of its users were compromised, increasing the amount to a staggering 3 billion affected accounts. This information is based on "new intelligence" uncovered in the investigation by external forensic experts and Verizon, who recently acquired the company. **HD**

NBN rollout responsible for staggering amount of TIO complaints

ACCAN tells them to get their act together.

Shortly after NBN Co released a statement promising that it would focus on NBN customers who have been left without internet connections, the beleaguered network has found itself under fire once again thanks to the annual report from the Telecommunications Industry Ombudsman (TIO). There are plenty of overwhelming stats in the report when it comes to complaints about internet service, but the crux of it is that, in total, they've risen quite dramatically since last year – including a staggering 160% in the NBN's case.

The Australian Communications Consumer Action Network (ACCAN) has made its concerns known in a public statement, condemning the customer service performance of both internet providers and NBN Co itself, and suggesting improved community safeguards and a revised Customer Service Guarantee (CSG). In response to the figures, NBN Co released its own statement, mostly dodging the accusation and shifting some more blame onto retail service providers, while simultaneously pointing out how difficult and large the project really is.

CEO Bill Morrow said in the statement that less than 15% of the complaints to the TIO actually end up reaching NBN Co, but that the company is still taking the issues very seriously. **Harry Domanski**

Divide and conquer: Russia accused of using Facebook ads to polarise US electorate

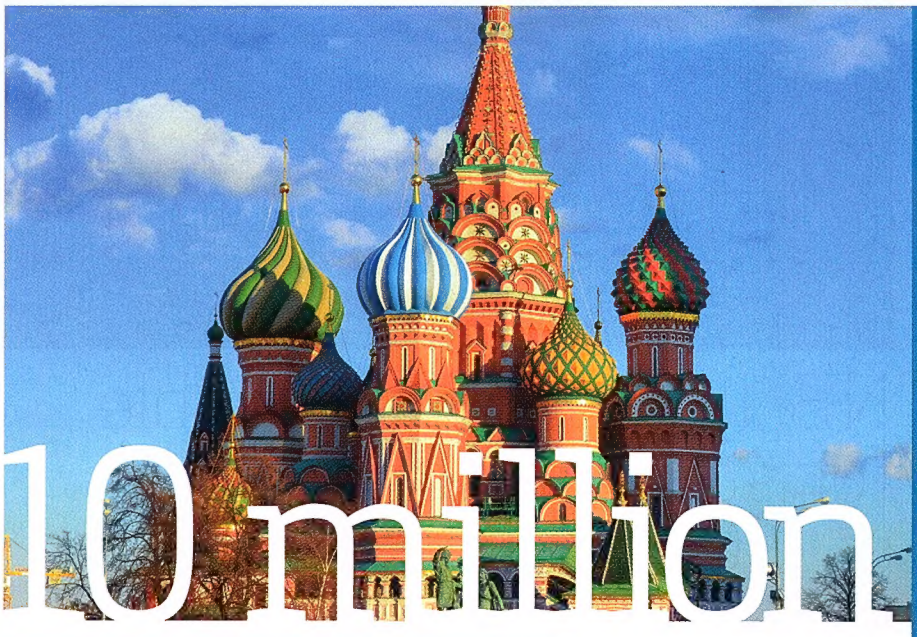
ZUCK PROMISES MORE TRANSPARENCY.

Investigations have revealed that over 3,000 political ads on Facebook were paid for by Russians during the last US Presidential election campaign. These ads, seen by an estimated 10 million Americans, mostly targeted folk in Michigan and Wisconsin, states that were pivotal in Donald Trump's success with the Electoral College. According to unnamed CNN sources, some of these ads were anti-Muslim.

In the wake of these revelations, Mark Zuckerberg has not only promised to release all the ads to the investigators, but is making political advertising more transparent on the social media site. In the US, politicians are required to reveal who is paying for their ads on television, but that's not the case for adverts placed on social media. "Going forward [...] we're going to bring Facebook to an even higher standard of transparency. Not only will you have to disclose which page paid for an ad, but we will also make it so you can visit an advertiser's page and see the ads they're currently running to any audience on Facebook," wrote Zuckerberg on his page. **Sharmishta Sarkar**

numbercrunch

» HARRY DOMANSKI LOOKS AT THE NUMBERS DRIVING THE BIG TECH NEWS



10 million

AMOUNT OF FACEBOOK USERS THAT SAW RUSSIAN ADS DURING THE 2016 US ELECTION

Facebook has disclosed that, around the time of the 2016 US election, over 10 million of its users were exposed to divisive ads that were placed by a Russian propaganda agency. The Kremlin-linked group, known as the Internet Research Agency, were responsible for over 3,000 ad campaigns covering key issues such as gun control, race and immigration. Facebook is claiming that over half (56%) of these ads were displayed after the election had ended, but that still means 4.4 million users — around 1.35% of the total US population — were reached before they went to the ballot box.

29%

HOW MUCH AUSSIE ANDROID TABLET SALES FELL IN THE FIRST HALF OF 2016

While overall tablet sales are dropping in Australia — 2016 saw a 10% year-on-year dip in the market — it seems to be Android that's bearing the brunt of the disinterest, according to data collected by market-research group Telsyte.

The first half of 2016 saw a 29% drop in Android tablet sales according to the company's research, and while Apple's range of tablets hold a 49% market share, Android only has 29% while Windows tablets sit at 22% — and continue to rise.

30GB

AMOUNT OF AUSTRALIAN MILITARY DATA STOLEN BY A HACKER NICKNAMED 'ALF'

Early in October, an Australian Defence subcontractor admitted that it had 30GB of data stolen — a trove which contained sensitive information on military equipment ranging from fighter planes to naval vessels. The Australian Signals Directorate (ASD) has been investigating the hack and has given the codename 'Alf' to the culprit, named after the long-running TV drama character from *Home & Away*. The ASD is taking the hunt for Alf very seriously until it can confirm the hacker wasn't a state actor.

US$5,000

BITCOIN'S PRICE CONTINUES TO CLIMB, GROWING FROM US$4,000 ONLY TWO MONTHS AGO

As cryptocurrency continues to climb in price and popularity, Bitcoin is still well and truly leading the charge. The 'coin surpassed the US$5,000 value milestone in mid October, only two months after reaching US$4,000 and one month after China banned cryptocurrency exchanges altogether. While no one is certain what caused the most recent spike in value (a whopping 10%), most are considering it be the result of increased interest in the currency from Wall Street banks.

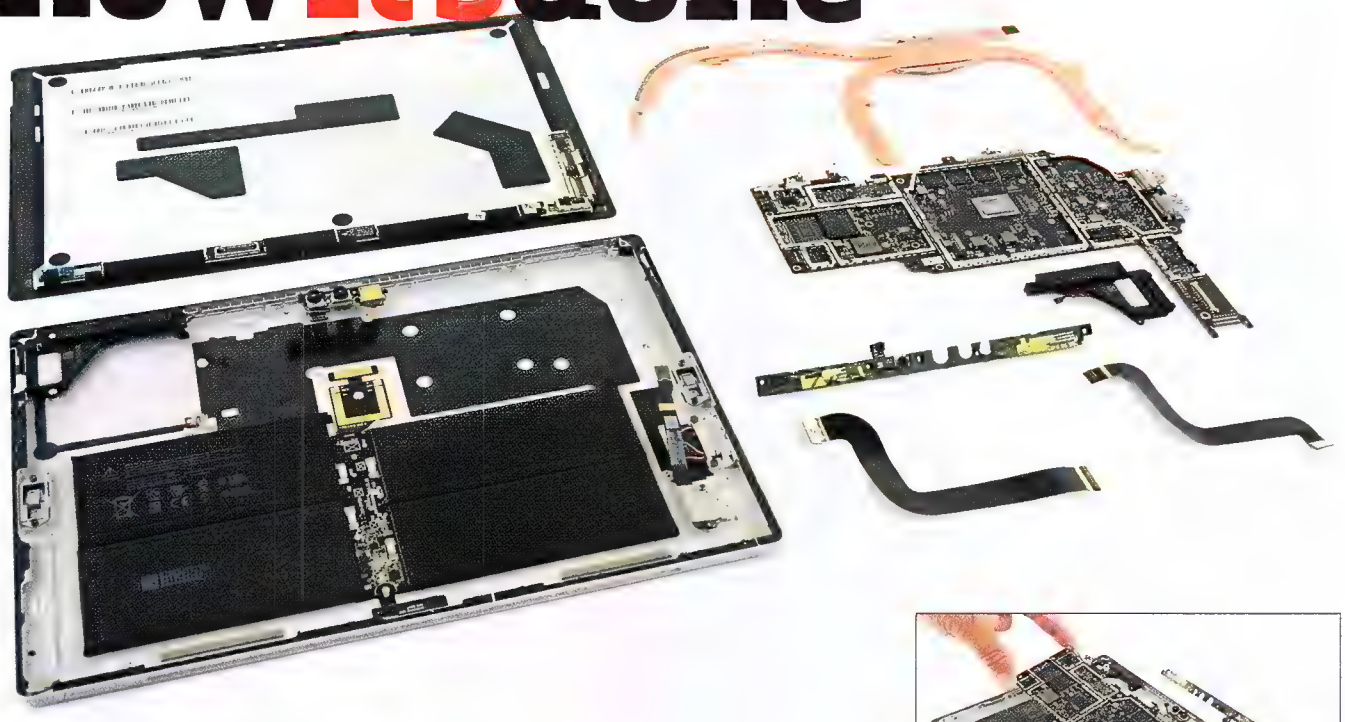
3 million

AMOUNT OF HOUSEHOLDS ACTIVATED ON THE NBN

The ill-fated rollout of the National Broadband Network (NBN) has finally presented some good news. NBN Co has announced that it has now activated the service in over 3 million Australian premises, while a further 2 million have access to the service but haven't activated it. This news comes 6 months after sign-ups reached the 2 million mark, and 17 months after the first million premises were activated, indicating an acceleration in activity.

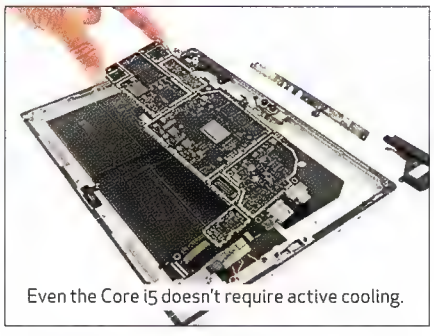
The company has also promised to start taking care of those customers that have faced delays of more than a month to get a working connection. ■

howit'sdone



Microsoft Surface Pro (2017)

Easy to use, not so easy to repair...



Even the Core i5 doesn't require active cooling.

Microsoft's hardware is having an identity crisis. The company calls this new Surface Pro "the most versatile laptop", which means that this apparent tablet is actually a laptop (that can transform into a Studio Surface). We're going to reach deep inside and see if we can help.

MAJOR TECH SPECS

- 12.3-inch IPS PixelSense display with 2,736 x 1,824 resolution (267ppi)
- Intel Kaby Lake Core m3 (4M Cache, 2.7GHz) up to Core i7 (4M Cache, 4.0GHz) CPU
- 4GB/8GB/16GB 1,600MHz DDR3L RAM
- 128GB/256GB/512GB/1TB of solid-state storage
- 8MP rear-facing 1080p camera, and 5MP front-facing 1080p Windows Hello camera
- USB 3.0 port, microSD slot, Mini DisplayPort, and SurfaceConnect charging port.
- 802.11a/b/g/n/ac Wi-Fi, Bluetooth 4.1

KEY FINDINGS

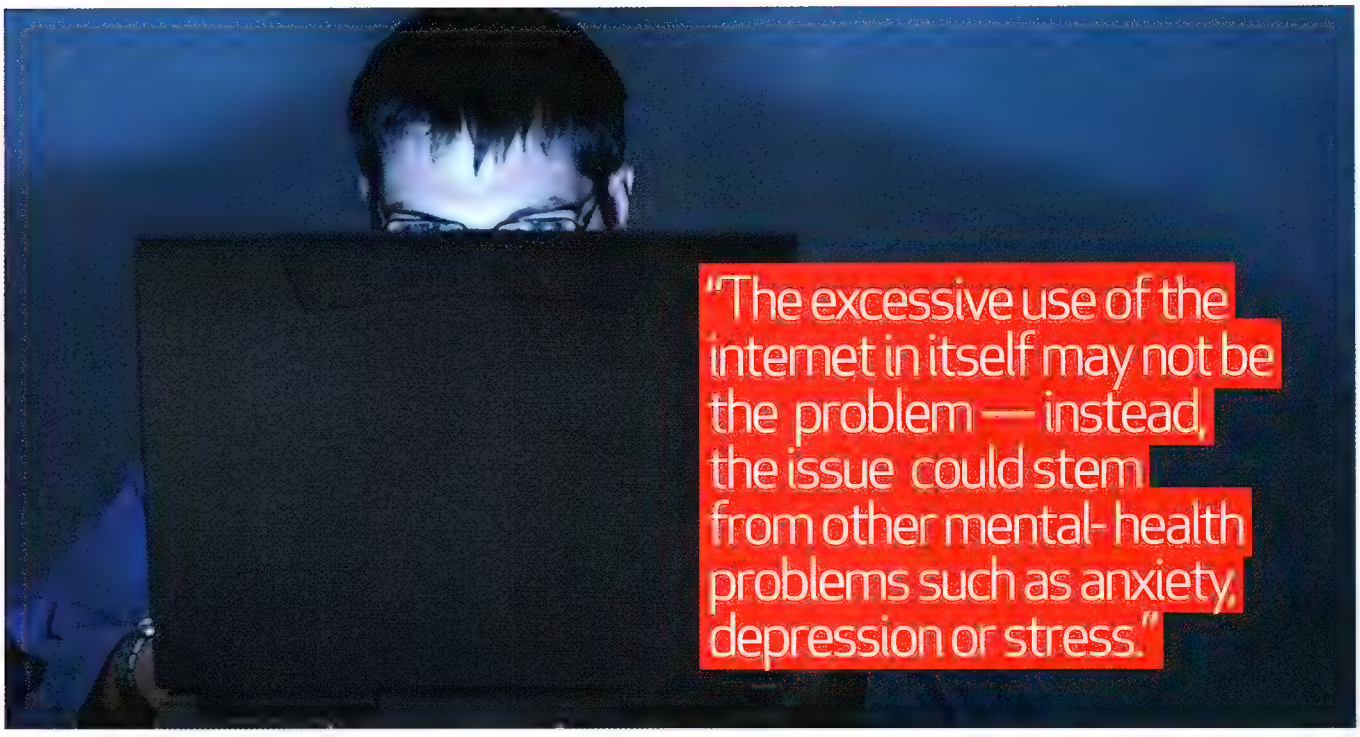
- Microsoft has traded away the removable blade SSD for more battery real estate. There goes the sole upgradable feature from last year's model. Less exciting differences include a more spidery heatsink design and four-cell instead of two-cell battery. The back of the display houses chips that look suspiciously similar to the N-trig modules found in the Surface Pro 4.
- Microsoft claims to have wholly redesigned the passive cooling, to allow both the Core m3 and Core i5 models to run 100% fanless, instead of just the m3 model, like last year. It looks as though most of the improvement came from shaping the heatsink like a certain Zerg unit. With the heatsink out of the way, we still have to remove a couple of components before the motherboard is free. It's trapped under one speaker and a sensor/camera bezel.
- If we learned anything from the last Surface Pro we tore down, it's that the battery is a pain to remove, and it doesn't go back quite the same. So we're gonna keep it glued in. This four-cell LiPo measures in at 45Wh (7.57V x 5,940mAh). That's nearly an 18% increase in battery capacity (and 100% increase in cell count) over the previous model. To compare, 10.5-inch iPad Pro sports a 30.8Wh battery.
- It's nearly identical to its predecessor – aside from ditching the modular SSD. Yeah, Microsoft impressed us – by being way worse than we expected. We also took a look at the Core i7 Surface Pro, and there's not much difference, but the mysterious empty space under the heatsink is filled with extra cooling power in the form of a fan.
- **Repairability Score:** 1 out of 10 (10 is easiest to repair). Although we like connectors, the ones here aren't standard, making display removal tricky; the procedure is simplified by the use of thin foam adhesive and a fused display, but is still not trivial. Adhesive holds many components in place, including the display and battery. Replacement of any part requires removal of the display assembly, an easy part to damage. The SSD is sadly no longer replaceable. ■

About iFixit

iFixit is a global community of tinkerers dedicated to helping people fix things through free online repair manuals and teardowns. iFixit believes that everyone has the right to maintain and repair their own products. To learn more, visit: **www.ifixit.com.**

techbrief

» CARMEL SEALEY WADES INTO A CURRENT NEWS TOPIC TO TAKE A CLOSER LOOK



Are we all caught in the web?

A look at the emergence of internet and device addiction in the information age.

A brief glance around the carriage on a morning train commute will reveal that most of us modern-day, first-world humans are very invested in our phones and connected lifestyle. And why not? Smartphones deliver news and information literally into our very palms. They help us keep our lives organised. They can allow us to connect with our friends and family, (and indeed almost anyone in the world) through social media. They allow us to monitor our own health. They can prevent us from getting lost. And when we have some downtime, they provide a handy platform for entertainment.

However, the combination of mobile phones and the internet has seen a rise in what has been called by many medical professionals as 'internet addiction'. But what is it, should we be worried and how can we fight it?

IS IT REALLY 'ADDICTION?

The word 'addiction' has many of us thinking of substance abuse, such as smoking, drugs and alcohol, but can we really put these conditions into the same bag as behaviour that's harder to pin down, like 'the need to be constantly online'?

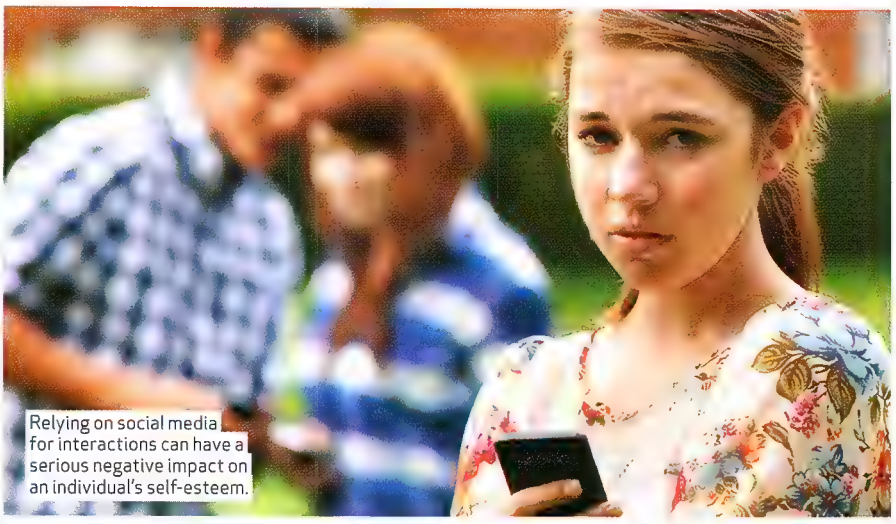
With substance abuse, the subject is introducing something into their body that is physically and negatively affecting them. Internet addiction, however, is slightly different, and could be classified as a 'pathological behavioural condition', similar to an eating disorder, compulsive gambling or working obsessively. But psychiatrists Marc Potenza and Robert Leeman from Yale, Connecticut, have recognised similarities between the two types of addictions (**tinyurl.com/apc448-study**), identifying that the most obvious parallel is that the victim is unable to control their behaviour, even if they're aware of the potential consequences.

According to psychiatrist Dr Anna Lembke from Stanford University, California, symptoms of internet addiction can include "insomnia, dysfunctional relationships and absent days at work or school", just like other addictions (**tinyurl.com/apc448-nprreal**). Other side effects can also include anxiety, depression, low self-esteem, a decline in physical health and proper eating habits, as well as mood swings. So the plight of those suffering from this is very real and, like gaming addiction, should be taken seriously.

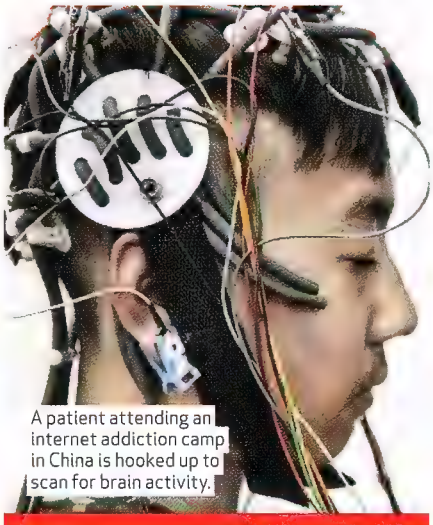
CONSTRUCTIVE OR DESTRUCTIVE?

Well, that's it, isn't it? We must ban the internet! Steady on... One thing we should probably make clear is that excessive use of the internet is not necessarily a bad thing. We in the *APC* office, for instance, are online in one way or another our entire working day: researching, writing, watching the odd cat video and connecting with our broader community. So it's what the individual is doing online that should really be the focus — is that time being used constructively or destructively?

For example, if Subject A spent more than five hours on social media each day, waiting for likes, retweets and mentions, and growing increasingly anxious and depressed, that is hardly the same as Subject B, who spent the same amount of time online learning a coding language or watching how-to videos to improve their photography skills. After all, the internet is just a medium — and an invaluable one at that.



Relying on social media for interactions can have a serious negative impact on an individual's self-esteem.



A patient attending an internet addiction camp in China is hooked up to scan for brain activity.

THE NEW NORMAL

In our ever-connected world – where both work and play can involve some sort of online presence – is it even possible for those with a problem to distance themselves? Psychologist Jeff Nalin says that, rather than going "clean and sober", to tackle the excessive use of the internet, "you have to learn the skills to deal with it".

Psychiatrist Potenza adds that society has not yet decided what the 'normal' amount of internet usage is or should be. "It's not like alcohol, where we have healthy amounts that we can recommend to people," he explains.

There are many different things to consider when thinking about treating internet addiction. For example, does Subject A feel depressed because of social media or do they turn to social media because they feel depressed? Therefore, is the internet the cause or simply an outlet? Despite the fact that internet addiction has not yet been officially recognised (medically speaking) in Australia, there are many avenues where those who suffer from addictions and other mental health conditions can get help.

GETTING HELP

As we touched-on above, the excessive use of the internet in itself may not be the problem – instead, the issue could stem from other mental-health problems such as anxiety, depression or stress. If you believe you have a condition that you need help with (or know someone else who might), your first port of call should be beyondblue (**www.beyondblue.org.au**) or LifeLine (**www.lifeline.org.au**), or indeed your friends and family. Because, above all else, if the internet (or your actions online) are keeping you away from your loved ones, it's probably time to log out and reconnect – with the real world.

Booting up?

In 2016, a documentary was released (**rtd.rt.com/films/chinas-digital-detox**) detailing how China was handling the rise of internet addiction. While the country is one of the first in the world to recognise the condition, China considers it a shameful disorder and treatment is often forced upon the patients and delivered in a boot camp-style rehab environment. Proscribed treatment activities include marching, standing still for 20 minutes, attending lectures and having one-on-one sessions with a psychologist. While exercise can prove invaluable in improving an individual's health, both physical and mental (**tinyurl.com/apc448-exercise**), we're not convinced these camps are the best way to go.

While the online aspect of young people's lives is now considered by many as vital, it's important to meet up IRL, too.

Think of the children!

There's an assumption that Gen Y are particularly guilty of excessive internet use. Children now go to school with laptops and phones in their bags, where most of us here at *APC* (and many of our readers, too) merely had books and a pencil case! But while, yes, it's unacceptable to be constantly looking down at your phone while walking, or checking emails instead of talking to your date, or choosing to 'hang out' online exclusively rather than in person, the way in which we live our lives is constantly changing and, whether we like it or not, becoming more connected. Moderation, as always, is key.

gadgets

» GEAR WE WANT

GOOGLE PIXEL BUDS

A budding new wireless headphone contender.

$249 | STORE.GOOGLE.COM

One of the key features of this year's best wireless headphones is the integration of digital AI assistants. Google may not have much experience in the consumer headphone space, but it's clearly got an advantage in integrating the company's Android-based Assistant app into its new Pixel Buds. In addition to rapid Assistant responses, the Pixel Bud's boast real-time in-ear language translation when paired with Google Translate on a Pixel 2 smartphone. Add in a 5-hour battery runtime, with another five-odd refills available in the charging case, and you have an impressive feature set that'll contend with the best buds in the business. **JB**

FITBIT IONIC

A charged particle in fitness wearables.

$450 | WWW.FITBIT.COM

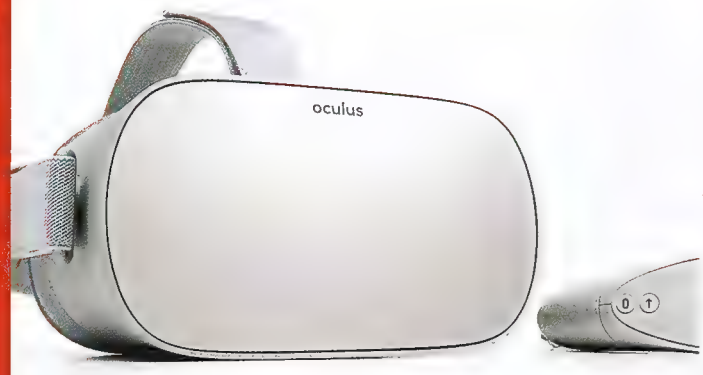
There's a delicate tradeoff in smartwatches, where boosting the functionality causes an increase in power consumption and subsequent decrease in battery life. Fitbit seems determined to buck this trend with its new Ionic smartwatch, which offers more than 4 days of battery life but still includes inbuilt GPS tracking, contactless payment, local music storage and Bluetooth headphone streaming. This fitness wearable has also added an oxygen saturation sensor for additional sleep-quality and fitness metrics, an improved heartrate tracker and 50m depth water resistance (with the software to track aquatic exercise sessions). **JB**

SAMSUNG HMD ODYSSEY

Samsung sets its VR sights on the PC.

US$499 | WWW.SAMSUNG.COM/AU

At a Microsoft launch event for Windows Mixed Reality (aka, the new, less-demanding VR and AR platform that's part of the upcoming Fall Creators Update), the software giant unveiled a number of new VR headsets in partnership with major hardware makers, including this beauty from Samsung. The HMD Odyssey will join already-announced headsets from Acer, ASUS, HP and Lenovo, all of which will be compatible with the new VR/AR interface that's lightweight enough to run on the integrated-graphics chips of today's ultrabooks. Samsung's US$499 HMD Odyssey is the most expensive mixed reality proposition that's been announced so far, but with two AMOLED 1,600 x 1,440 pixel displays that can run at 90Hz, a pair of handheld controllers and multiple optical motion-tracking sensors, it looks like the pick of the bunch. **JB**



OCULUS GO

Could this be the unit that brings VR to the masses?

US$199 | AVAILABLE EARLY 2018 | WWW.OCULUS.COM/GO

Aiming to fill the chasm between high-end, PC-powered VR headsets and inexpensive goggles that rely on your smartphone, Facebook-owned VR giant Oculus has announced its first standalone headset, the Go.

The unit will integrate its own processor hardware so it operates completely independently, plus there's a newly-designed 2,560 x 1,440 LCD screen that aims to reduce both latency and the 'screen-door effect' – or the lines that sometimes appear between pixels in current VR units. The unit will also feature integrated speakers for 'spatial audio' and a 3.5mm headphone jack if you want to bring your own headphones.

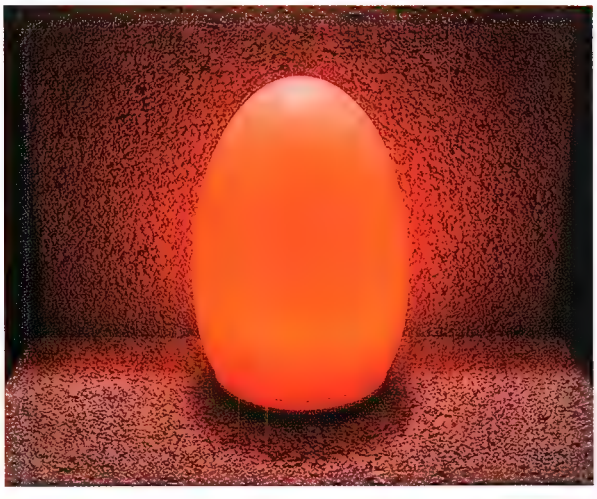
The Oculus Go will be compatible with all the apps, games and movies currently available in the Samsung Gear VR library, but we haven't been told if it will be able to handle full Oculus Rift titles – we're guessing not, given the very low price. **HD**

PALETTE GEAR

A sweet suite of controls for your Adobe Suite needs.

FROM US$199 | WWW.PALETTEGEAR.COM

For creatives working with computers, there are dozens of neat solutions to better interface with their software of choice, but the Palette Gear promises to be both specialised and flexible by focusing its efforts on working with the Adobe Suite of apps. The Gear consists of an interchangeable array of four modules – Core, Button, Dial and Slide – that can be configured on your desk as you please courtesy of magnetic connectors. Plug the Core module in via USB and you'll be free to turn up the contrast of your photo, scrub through your film or arm the recording on your track with the dedicated and highly customisable controls. **HD**



ELGATO AVEA FLARE

A great mood light for indoors and out, though a bit pricey.

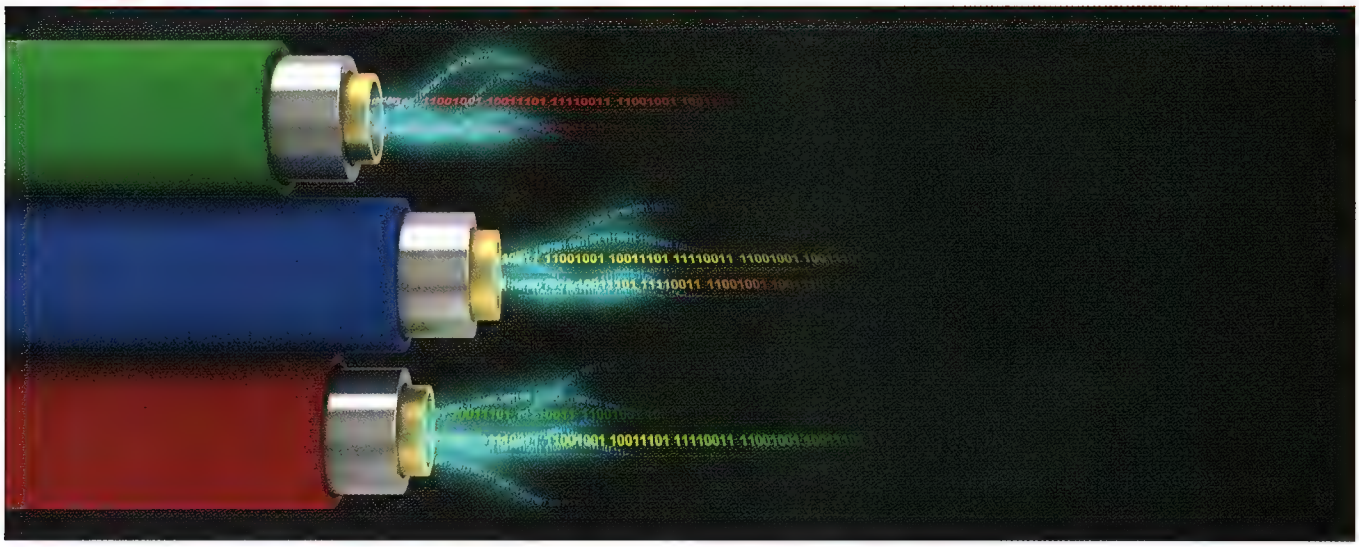
$85 | ELGATO.COM

The Elgato Avea Flare's egg-shaped design looks great anywhere you put it, and its battery power enables it to be carried all over; even outdoors, thanks to IP65 waterproofing. Elgato's lamp offers a whopping eight hours of battery life, and the wireless charging base makes it easy to juice up.

Although the name would suggest an eye-searing light output, in reality, this is anything but, with just 60 lumens of brightness; it's one for enhancing the mood rather than lighting a room, though multiple lights can be joined to increase output. If you do this, the app will automatically recognise each light and coordinate their output accordingly.

The app offers loads of cool mood scenes, our favourite being the flickering fire, and Flare can also be used as a wake-up alarm, using a combination of light and sound.

epinions



NBN ROLLOUT PRIORITIES

Just in response to the June issue's reader letter about the NBN being not worth having: from my perspective, there have been multiple problems with the way the rollout has been handled.

Primarily, was anyone asked if we needed a whole nation upgraded at the same time to this type of network? Could we perhaps have had a slower but better deployment over a longer period using the money from users targeted at suburbs with high levels of broadband saturation to start with, before then moving to lower-penetration areas, deploying to regional Australia and more remote areas later.

I understand why we need to support regional centres, but if those areas have low ADSL uptake already (which may be due to a non-existent service or need), then they should not always be at the forefront. Instead, those rollouts could be funded (I feel) sooner by high-use areas having deployment first, if able.

A prime example of this kind of rollout wastage is for my mother, who lives in Taree and has FTTP, as do six of her neighbours. However, none of them own a computer or use the NBN other than for home phone use. Thats some $27,000 spent to connect homes that, for at least the next 10 years, really have no need for the NBN in the first place. One can't help but feel it could have been done a whole lot better, and infinitely smarter.

Currently, I only get ADSL speeds of 2.46/0.56 and, unfortunately, will only be receiving FTTN when the NBN reaches me. I'll be getting the lowest plan I can, as both my sons already spend far too much time on computers and will waste more time if I get more bandwidth and download limits.

I'm sure many parents will need to look carefully at what is educational versus recreational use of data once they have the NBN. Our businesses/health/education systems should be at the forefront of any advantage gained with the NBN. In my opinion, gaming and such should be considered a lower priority, unless it has economic benefits for employment.

Jason Robards

"I understand why we need to support regional centres, but if those areas have low ADSL uptake already (which may be due to a non-existent service or need), then they should not always be at the forefront."

Clarification on KeePass availability

In the 'Secure your digital ecosystem' feature on page 52 of *APC*'s October edition, a sentence describing open-source password manager KeePass could have been read to imply that the program is only available on Windows. While this is partially correct — the official client is only offered on Microsoft's OS — there's also a range of third-party ports of KeePass available for both desktop operating systems (including Mac and Linux) as well as iOS, Android and even Windows Phone. We apologise for any confusion this may have caused.

APCMAG@FUTURENET.COM

Come on, have your say!

We want to hear what you think. Add to these discussions or email your views (in fewer than 250 words) to **apcmag@futurenet.com**. All correspondence becomes the property of *APC* and is subject to editing. Letters must include full name, street address, suburb, state and phone number to be considered for print publication. Address and phone details will not be published.

Is your phone being deliberately slowed down?

It's a widely held belief that smartphones get slower over time, but is it all in our minds? Shaun Prescott investigates.

Your shiny, cutting-edge smartphone is only cutting-edge for, at most, a year. Then the inevitable new iteration rolls around, and while yours is still functioning fine, it starts to lose its lustre. How can you possibly bear to cart around a slovenly iPhone 7 when there's a shiny, magisterial iPhone X waiting in a glass box at JB Hi-Fi? That's normal among enthusiasts – the desire for the best – but are there more ominous forces at play? More specifically, is that older phone designed to run slower on a system level in a kind of subtle, underhanded way to try and get you to upgrade?

The short answer is 'kind of' – but it's not actually the hardware that's to blame. That's a fact made clear from a recent benchmarking project by Futuremark, a company responsible for industry-respected benchmarking tools for PC, smartphones and more (we use several Futuremark tools here at *APC* to benchmark hardware). The company generated results for 100,000 iPhone models across three iterations of iOS – 9, 10 and 11. Measuring the efficacy of the phone's GPU and CPU over the course of an 18-month period, the company found that neither component deteriorated in quality. Indeed, they tended to perform near identically. This held true for the iPhone 5, 6, 6s and 7.

That puts paid to the concept of planned obsolescence, right? Well, not really. It's comforting to know that Apple's smartphones can run at optimal levels, on a hardware level, for at least 18 months. But these results don't factor in the swathe of other elements that can contribute to a phone "slowing down". Indeed, a new iOS for an older model can make a noticeable difference to operation, not only because new features may be more hardware intensive, but also because older apps may not be optimised to take advantage. (There's also a lot to be said for the way apps, like Facebook and Instagram, can get so overloaded with new features that they start to run more sluggishly over time.)

In the words of Futuremark: "An [app] update might add new features that use more resources or require more processing power. New apps developed for the latest models might not run as smoothly on older devices. Conversely, apps designed for an earlier version of iOS might not take full advantage of optimizations in the latest version."

This report may convince some people to hold on to their old phones for a bit longer – probably a more sensible and sustainable outcome. The hardware is fine – it's just the apps you're using. Consistently performing hardware doesn't absolve Apple from its other obsolescence crimes, however – like hard-to-replace batteries or phasing out widely-used ports – but things aren't quite as deliberate or underhanded as they might seem. So if you're in the market for a new iPhone or Samsung Galaxy, maybe hold on to your old model for a bit longer before you send it to landfill... ■

END USER

Share your stories!

If you have an interesting story about technology users, their experiences and the issues that affect us all (whether funny or serious), email us at **apcmag@futurenet.com**. All correspondence becomes the property of *APC* and is subject to editing. Letters must include writer's full name, street address, suburb, state and phone number to be considered for print publication. Address and phone details will not be published.

Head to head: LCD panel tech

Alan Dexter pits the competing TN, VA and IPS monitor techs in a head-to-head battle to discover which one is superior.

Choosing a panel type used to be simple. You chose TN if you were cheap or wanted to game, or IPS for almost everything else. Now, it's not so easy. The best TN tech has improved dramatically, though the benefits have only touched a minority of monitors. Meanwhile, IPS panels have become far cheaper, and VA tech keeps throwing in that high-contrast curve ball, thus offering a flawed but compelling alternative. Meanwhile, the PC is now so capable that the range of uses and applications, not to mention screen sizes and resolutions, are so varied that the pros and cons of the three main panel techs are more nuanced than ever. So let's settle this once and for all. In a three-way Mexican standoff between TN, IPS and VA, which comes out on top?

Round 1

GAMING

If there's a single application type you can rely on to hammer your PC into whimpering submission, it's gaming. No surprise, therefore, to find that it's gaming that makes for quite the conundrum when it comes to choosing panel tech.

On the one hand, you want zingy colours, plus plenty of pop and contrast in your games, right? VA it is, then. Of course, colour accuracy also counts, especially when it comes to picking out enemies in shadowy, low-contrast scenes. Better make it IPS. But hang on, you also want zippy pixel response, the highest possible refresh rates and the absolute minimum of input lag. Can we change that to TN, after all?

Whatever you go for will be a compromise. For instance, the latest IPS monitors aimed at gamers have begun to adopt refresh rates of 120Hz and more. Likewise, panels of all types can be had with frame-synching and performance-smoothing Nvidia G-Sync and AMD FreeSync tech. But in the end, the most rewarding gaming screens are the ones that handle motion best. And that undeniably means TN.

The good news is that TN has come on a lot in terms of colours and contrast of late. So it's not the bum steer it used to be by those broader metrics.

WINNER:
TN

Round 2

VIDEO PLAYBACK

You could argue that any LCD technology is doggie-do when it comes to video playback. Shining a light through a huge number of imperfect shutters is a pretty dumb idea compared to an OLED panel, say, where each pixel is its own light source. And yet LCD technology has developed to the point where it has very nearly – but not quite – shaken off its inherent shortcomings.

For watching video, that means a number of things. Colours and contrast are super-important for pure visual pizzazz, and VA, with its super-high contrast capability, scores heaviest and delivers the most superficially impressive results with video. IPS technology has closed much of the gap when it comes to contrast, but the specs do not entirely lie. VA panels with static contrast capability of 3,000:1 or more are now common. That is simply beyond the capabilities of IPS tech.

However, accuracy also counts, especially if you like a more natural vibe with your video and movies. In that scenario, IPS tech works best. Of course, pixel response is also important, given that video involves motion. But the downsides that TN brings to video in pretty much all other regards rule it out of the running in this category.

TIE:
IPS and VA

Round 3

CONTENT CREATION

Of all the categories here, content creation is probably the only one for which the preferred panel technology is a near 100% nailed-on certainty. It's IPS you want. That's because IPS is comfortably the most accurate LCD panel technology available.

The point is that IPS gives you the best chance of ensuring that whatever content you're producing at your end looks right when it's consumed at the other end. If you want to colour correct for print, for instance, it's the obvious choice. Admittedly, if some of your audience insists on using substandard viewing devices – perhaps a PC with a wonky TN panel – there's only so much you can do. But the point remains: IPS is the way, the truth and the light for accuracy.

If there are exceptions, the first would involve cost. Aside from accuracy, having a high native resolution is desirable in terms of being able to view large images and high-definition video within the bounds of an editing app. And that can be expensive with an IPS panel. At least, it used to be. The cheapest 27-inch 4K IPS monitors are now roughly only 10% more expensive than a TN equivalent. IPS is pretty much a no-brainer, therefore.

WINNER:
IPS

Round 4

GENERAL DESKTOP USE

Want a horse? Then you'd better know the course. And so it is for choosing a panel for general desktop use. Much depends on your preferred mix of apps, your viewing environment, and your budget.

Not too long ago, cheapskates could find great value in something like a 4K TN panel. TN tech in that format offers surprisingly good colours and contrast, and the 4K resolution provides oodles of space for juggling app windows. More recently, however, IPS and VA prices have tumbled, and the price delta has dwindled to decidedly insignificant proportions. And so the choice narrows to IPS and VA.

For general use, though, IPS has the edge. That's primarily down to superior viewing angles. It's not that VA viewing angles are poor per se, but the consistency of IPS makes for a more pleasant general computing experience. It just feels right, while VA, on the other hand, is superficially punchier, yet ultimately less pleasing to the discerning eye. The exception might be using a panel in extreme ambient light conditions, be that exceptionally bright or dark. In both cases, you might then lean toward choosing VA. In bright conditions, the extra pop is welcome; while in a very dark environment, you'll appreciate the reduced backlight bleed.

WINNER:
IPS

Round 5

WEB AND OFFICE

For web and office work, it's all about the pixels – or, more specifically, how many of them your screen has. It's actually a more complex question than you may at first consider, given that you have to factor in both the actual resolution in horizontal and vertical pixels, and then the panel size. Together, that determines the pixel pitch.

The problem, in this particular context, is that the world of computing isn't yet entirely, you might say, DPI agnostic. In other words, much of the web, and even some bits of the Windows GUI, are based on static bitmaps, which scale poorly if you bump the Windows DPI setting away from 100%. That can make for problems with very high DPI screens. Go for, say, a 24-inch 4K screen, and you'll be forced to choose between wonky Windows elements and blurry bitmaps on the one hand, or stupid-small fonts and icons on the other.

The final reckoning for this category doesn't map terribly well to panel type. However, if you can afford it, the accuracy of IPS, combined with high resolution at the right panel size, is the optimal choice. But both VA and TN technology can make for pleasant enough web and office partners.

WINNER:
IPS

And the winner is...

If there can be only one winner, then it has to be IPS. It's not the best panel tech by each and every metric — VA panels offer superior contrast and superficial pop, while TN screens are faster — but IPS's overall balance of qualities simply cannot be beaten.

Indeed, it's actually when you put all the objective tests to one side and simply absorb the look of a screen that IPS scores most heavily. Monitors using other panel technologies often have a certain wow factor —for instance, the punchy colours or deep contrast of a big VA panel — but if you discover the *APC* crew huddling around the latest LCD marvel, and quietly muttering, "By Azura, that's lovely!" it's almost always an IPS panel.

Of course, there are exceptions. If speed is critical, TN still rules. Likewise, at any given price point and form factor, there may be conspicuous bargains that push the value proposition toward either VA or TN. However, as pricing continues to converge, that's less often the case.

As Principal Rooney said, "Les jeux sont faits for other screen techs."

(Translation: Choose IPS.) ■

apc RECOMMENDS

INTEL CPU

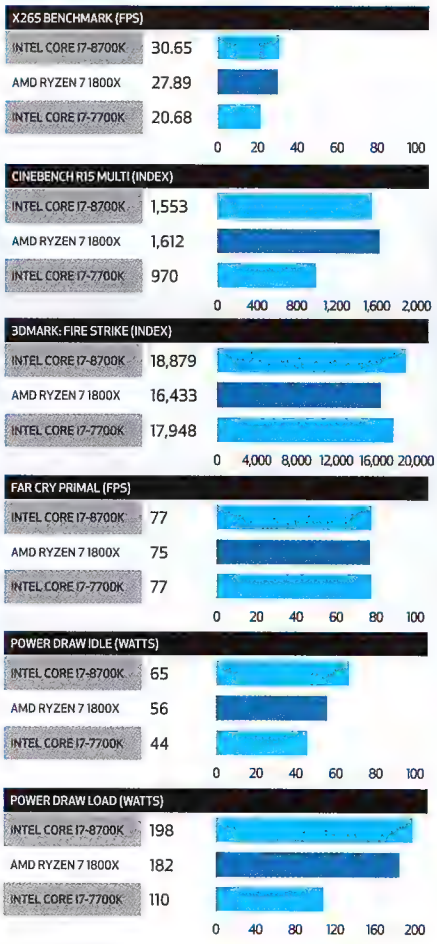
$589 | WWW.INTEL.COM.AU

Intel Core i7-8700K

Day-old coffee, or freshly brewed espresso?

LABS BENCHMARK RESULTS

General performance



It's been one hell of a year for processor launches: Kaby Lake, Ryzen, Threadripper, Skylake-X, Kaby Lake-X and now Coffee Lake. That's six different SKUs in less time than it takes to spit, each housing a plethora of fantastic advances for the computing enthusiast. It's hard to deny just how much of an effect AMD's Ryzen has had on the industry. Intel, in particular, has upped its game in response to the multithreaded prowess of the red core. And that response has come in two forms: Skylake-X to combat Threadripper at the high end, and Coffee Lake in the mid-range.

So what's so different? Not a lot. Coffee Lake's architecture isn't very different from its Kaby Lake predecessor – it's more a refinement. The big change lies in core count. Intel has reshuffled both core and thread counts across its range. The Core i7-8700K features 6 cores and 12 threads, the Core i5 has 6 cores and 6 threads, the Core i3 comes with 4 cores and 4 threads, and (if the rumours are to be believed) the Pentium has just 2 cores and 4 threads.

It's still shy of the 8 cores found on AMD's Ryzen 7 1800X. However, Intel is banking on its outstanding single-core performance, established platform, memory support and competitive pricing to level the playing field.

And the Core i7-8700K is impressive. Although architecturally identical to its predecessor, both its synthetic and real-world benchmark performances are exceptional. Scoring 1,553 in Cinebench R15 puts it just 60 points behind the Ryzen 7 1800X. With that single-core performance, though, the 8700K comes in at 205 points, versus Ryzen's 159. This also translates in-game – it scores higher than any of the processors we've tested in the last year.

Intel's core architecture is a well-established platform. Whether it's in-game performance, memory support or platform reliability, it just all works.

There are caveats to this 'more cores' approach, however. We've seen power draw increase by over 88W under load, compared to the last-gen Core i7-7700K, even drawing 10W more than Ryzen's 1800X, and temperatures are elevated, too. Under our 280mm AIO, temps easily hit 70°C or more at stock.

It's a well-established fact that Intel still refuses to solder the IHS to the dies of its CPUs, leading to higher temperatures, which is disappointing. Adjusting the manufacturing process to go back to that Sandy Bridge-style of solder would have alleviated these issues, and allowed for beefier stock clocks on the majority of its parts, without necessarily losing out on stability, potentially enabling team blue to surpass AMD's Ryzen flagship with little risk.

Hence, the overclocking is not as stellar an experience. Although we managed to get our chip up to 5.2GHz (maximum true turbo sticks resolutely at 3.7GHz), both temps and stability held us back from going any further. Again, we're at that point where the only solution would be to delid the processor to take it higher, which isn't exactly enticing for the average user.

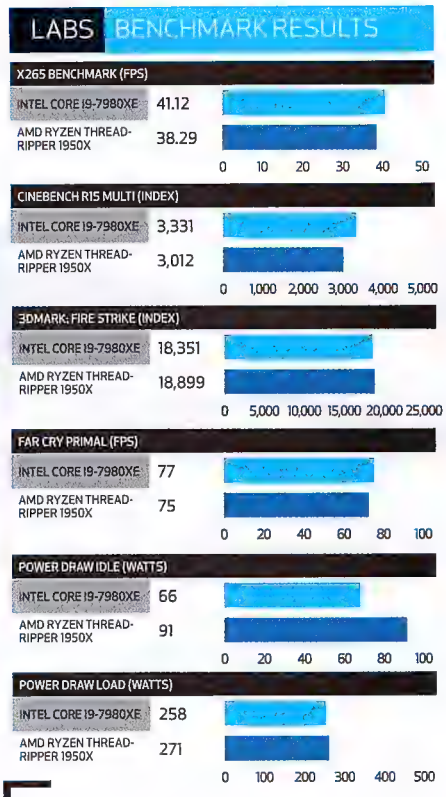
The Core i7-8700K comes at an attractive price, too, and unless AMD can really drop the price points on its Ryzen components, it makes far more sense for everyday upgraders to opt for team blue over team red, at least until Ryzen 2 arrives next year. ■ **Zak Storey**

Verdict

Features ★★★★½
Performance ★★★★½
Value ★★★★½

With this price and the advantage of being a well-established platform, it's an impressive retaliatory blow to Ryzen.

★★★★½



$2,859 | WWW.INTEL.COM.AU

Intel Core i9-7980XE

Be careful what you ask for. You might just get it...

For years, we've been begging Intel to cut the crap and launch some really exciting CPUs that properly push the boundaries of performance. After all, Intel's Xeon server chips have offered huge core counts well beyond its desktop lines for years.

Then Intel suddenly revealed plans for chips with up to 18 cores and, somehow, there was scepticism. It seemed like a cynical ploy to undermine the impact of AMD's Ryzen Threadripper processors. That notion was only enhanced by the fact that Intel announced the new many-core models without revealing detailed specs. Knee jerks all around.

Today, we have the Core i9-7980X, the $2,859 daddy of them all, in our eager paws, and what a monster it is with its 18 cores and 36 threads. To those, you can add a base clock of 2.6GHz, a Turbo speed of 3.4GHz and a TurboMax of 4.4GHz. If that 2.6GHz figure looks pretty puny, in practice, the actual operating speeds of these new many-core chips are quite complex. They involve a sliding scale that starts with that preferred-core 4.4GHz, and gently tails off to 3.4GHz with all 18 cores heavily loaded, albeit with the proviso that the AVX floating point engines aren't maxed out. In that scenario, speeds will be lower, though it's not clear how much.

In between, there's a number of intermediate frequencies that come into play when several cores are loaded, but not all 18. For instance, with between 5 and 12 cores under load, you can expect a frequency of 3.9GHz. From all of this, there are two take-homes. First, forget about that modest-looking 2.6GHz. Nearly all the time, this is at worst a 3.4GHz chip. Second, when the core counts get this high, even the seemingly simple question of how fast a CPU runs becomes complicated.

Elsewhere, the specs look as beefy as you'd expect. The 7980XE slots into Intel's LGA2066 socket, hooks up to four DDR4 memory DIMMs and supports quad-channel frequencies up to 2,666MHz. You also get 1.375MB of L3 cache memory per core for a total of 24.75MB, plus 44 PCI Express lanes directly into the chip. That latter figure is, perhaps, the only area where the 7980XE looks a little lightweight versus its Threadripper nemeses, which pack 64 lanes.

What even the top 16-core Threadripper can't do is match the 7980XE's stellar all-around performance. This CPU flies. It hammers the AMD competition in single-threaded tests. But the contest in multithreaded workloads isn't such a given, what with AMD's clever modular approach using two CPU dies to Intel's monolithic architecture. But in the end, Intel owns it all.

The 7980XE sails straight past the Ryzen 7 1950X's 3,012 points in Cinebench to record 3,331. Similarly, it's ahead at 41fps to 38fps in x265 video encoding. In Fry Render, the Intel chip completed the test in 64 seconds to AMD's 85.

Intel's architecture doesn't need complicated game modes, and it doesn't suffer from stutter in some titles, like AMD. For gamers, it's comfortably the better option.The 7980XE is also an overclocking beast. We got it running at 4.4GHz on all 18 cores, at which speed, it clocked a crazy 4,284 points in Cinebench, not to mention over 500W power draw at the wall. In short, this is easily the fastest and finest CPU in history. As well it should be at that price.

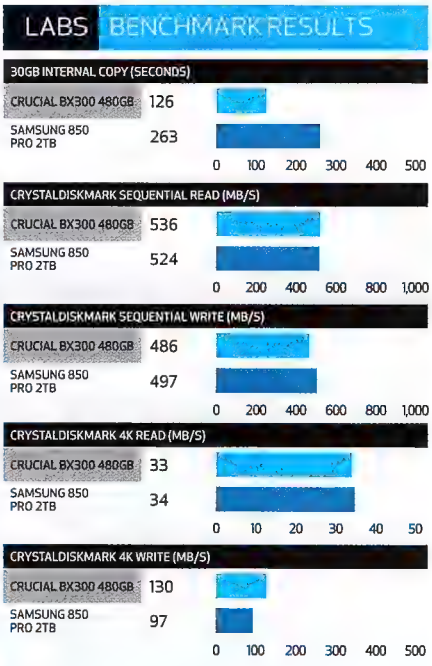
Jeremy Laird

Verdict

Features	★★★★★
Performance	★★★★★
Value	★★

Epic all-round performance with much better overclocking headroom than expected.

★★★★½



SSD

$190 (ESTIMATED) | WWW.CRUCIAL.COM

Crucial BX300 480GB

It's not sexy, but it is great value.

Keeping your expectations in check is not the most enthralling way to approach a new SSD, but it's very much the attitude to have when considering a standard SATA drive, such as the Crucial BX300.

For starters, it's a SATA drive in an age when SSDs hooked up via the far-faster PCI Express interface are becoming ever more mainstream. Not only is SATA limited to a real-world maximum throughput of about 550MB/s, but its control protocols were never intended to jive with solid-state memory. That means random access performance is compromised, compared with the full potential of the latest SSD controllers and flash memory.

What's more, the BX300 isn't merely a SATA drive. It's an aggressively priced one, sold as a value offering, rather than a premium performance proposition. This 480GB model should costs around $190 when it lands Down Under. A top-notch SATA drive in this about-500GB category, such as Samsung's 850 Pro, will hit you to the tune of $300. Even their value SSD, the 850 Evo, is pricier at $215.

Intriguingly, Crucial has wound back the clock technologically, and returned to MLC, or two-level, flash memory cells, each capable of storing two bits of data. Its previous budget drive, the BX200, ran with TLC, or triple-level. But this isn't old-school planar memory. It's 32-layer 3D NAND.

Other highlights include Silicon Motion's latest SM2258 controller chipset, 512MB of cache memory, and a write endurance of 160TB. Peak speeds for the 480GB model are quoted at 550MB/s for reads and 510MB/s for writes. 4K random reads and writes are 95k and 90k IOPS, respectively.

As for our tests, the BX300 cranks out some surprisingly good numbers. Sequential throughputs for both reads and writes are well over 500MB/s in ATTO Disk Benchmark. In CrystalDiskMark's slightly tougher test of sequential performance, the numbers are still strong, with 536MB/s for reads and 486MB/s for writes.

Even more impressive are the results in CrystalDisk Mark's 4K random access test. The BX300 spits out 33MB/s reads and 130MB/s writes. Those numbers compare favourably with a premium drive, such as Samsung's 850 Pro.

Of course, the subjective difference in terms of the computing experience delivered by various modern SATA SSDs has narrowed. You would be hard pressed to tell the difference in terms of how responsive each one makes a PC feel. Arguably of more significance is longevity, and that's where the BX300 betrays its budget intentions.

Crucial provides a three-year warranty, which matches other budget drives. However, Samsung's 850 Pro comes with 10-year cover. In the end, then, you pays your money and you make your choice. If you need an SSD with maximum staying power, the BX300 isn't for you, and you'll simply need to pay more.

For most, however, three years is a decent lifespan for a cheap SSD. In all likelihood, this drive will keep on trucking for many years beyond. Combine that with very respectable performance for a budget SSD, and you have a pretty awesome value proposition. Just so long as you keep those expectations reasonable. **Jeremy Laird**

Verdict

Features	★★★★½
Performance	★★★★
Value	★★★★½

Aggressively priced, but with solid all-around performance. It doesn't do anything spectacular, however.

★★★★½

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apc RECOMMENDS

WINDOWS 2-IN-1

$1,749 | WWW.ASUS.COM/AU

ASUS Transformer Pro T304

An attractive Windows 2-in-1 with some manageable trade-offs.

With Microsoft focusing its computing efforts on premium Surface laptops and tablets, there's plenty of room for copycat devices at a much lower price. The ASUS Transformer Pro T304 2-in-1 is a prime example.

Priced at about $1,749, the Pro T304 costs less than a similarly specced Surface Pro ($1,999) and comes bundled with a Transformer Keyboard Cover and ASUS Pen, whereas Microsoft's Type Cover and Surface Pen are extra costs.

Spec-wise, it comes with either an Intel Core i5 or i7 Kaby Lake processor, a 256GB/512GB SSD and 8GB/16GB of RAM. On the right side of the device is a small notch for easy access to the hinge, a speaker grille, charging port, USB-C port, full-sized HDMI port and a standard USB-A port. The left side features the same notch and speaker grille, followed by a MicroSD slot, volume buttons and headphone jack. On the rear of the T304 is a camera lens, and a solitary line cutting the device in half, as a marker for where the 155° kickstand hinge bends. A power button with a built-in fingerprint reader is found on the top-left corner. The bottom of the unit is where you'll find the connector for the keyboard.

The thought of pushing the power button and unlocking the T304 in one motion sounds convenient, and it is — when it works. The reader recognised our fingerprint only about half the time. On a few occasions, it refused to read our fingerprint at all, forcing us to enter a PIN or password instead. When it does work, however, by the time the screen is lit up and visible, the T304 is ready for work.

Weighing ever so slightly more than the 784g Surface Pro at just 811g, this tablet is super-portable. The 12.6-inch display is clear and vivid, but not the brightest. In direct sunlight, even with the brightness set to maximum, it can be difficult to clearly see what's on the screen. The touchscreen is responsive and accurate, however.

The Pen is fairly light and has two buttons, a left- and a right-click, which have a bit of an annoying wiggle to them. However, it travels smoothly across the display with minimal latency. As for the keyboard, it's spacious and the backlit keys offer a fair amount of travel. Using magnets, the keyboard can sit at a slight angle up off the desk for more ergonomic typing or lie flat.

We have no complaints about the Transformer Pro T304's performance. It's powerful enough to handle most basic computing tasks, but less assured when it comes to graphical performance, scoring just 1,341 in our 3DMark Sky Diver test, while the most recent Surface Pro scored 6,431. Similarly drastic results are also found in the Cinebench graphics test, with the Transformer Pro T304 scoring a lowly 17fps compared to the Surface Pro's 68fps — it's not a games machine, then. It does fare better when it comes to pure computing performance, scoring 4,238 in our Geekbench 4 CPU test, compared to the Surface Pro's 4,656. In our PCMark 8 battery life test, it clocked up a measly three hours and six minutes, a full hour less than on the Surface Pro.

There's a lot to like here, from basic computing performance to pricing, but it does have its caveats, in the form of the unreliable fingerprint scanner and poor battery life. If you're on a tight budget, however, it's worth considering.

Verdict

Features	★★★★½
Performance	★★★½
Value	★★★★

Powerful enough to handle most basic needs, just don't expect to use it for editing hours of video or any gaming.

★★★★½

apc RECOMMENDS

GAMING LAPTOP

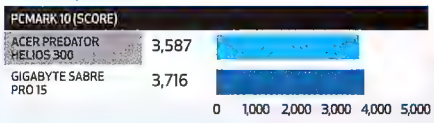
$1,977 | WWW.ACER.COM.AU

Acer Predator Helios 300

A pleasant and well-built gaming all-rounder that only slips in one key area.

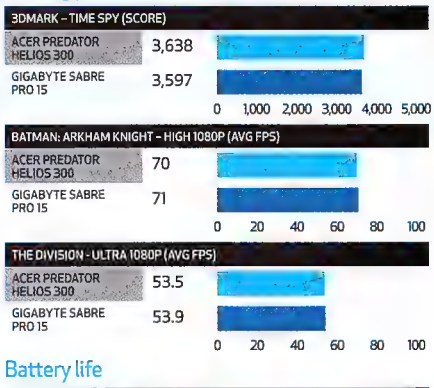
LABS BENCHMARK RESULTS

General performance

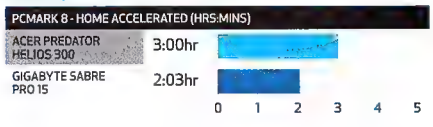


Media encoding performance

Gaming performance



Battery life



Acer's dabbled in gaming laptops on and off for years but, like almost every other major PC maker, it's now getting serious about this category – and that's largely because it's one of the most profitable when it comes to PC sales in 2017.

The 15.6-inch Helios 300 is the company's new entry-level gaming offering, and on the surface, it's pretty decent value. It's one of the cheapest 15-inchers to include a GeForce GTX 1060 graphics processor (you don't often see big brand-names like Acer being this competitive on price) and it packs that GPU into a handsome and stylish gaming laptop body – one which employs the kind of shawn-off angled edges that we've seen on Alienware's designs for many year alongside red-accented WASD keys and trackpad. It's a classy approach that, unlike some other gaming brands (we're looking at you, MSI), doesn't overdo it with the bling.

The underside of the Helios is tough black plastic, but sitting on top of that is a single-piece, black brushed-aluminium keyboard deck that keeps things sturdy. The back of the lid uses the same brushed metal, although the bezels surrounding the screen are plastic – that's a very common trade-off at this price point, and even all the way up to the $3,000 mark.

In use, the Helios stands up well – its firm, backlit chiclet keyboard offers a little more travel than most others, and the slightly left-aligned trackpad is nice and big too. Although the display is only a 60Hz/1080p job (you won't find features like G-Sync at this price point), it's at least an IPS panel with nice neutral colours and clean, clear visuals.

Driving the show is the nearly-ubiquitous (when it comes to gaming laptops) Intel Core i7-7700HQ, a quad-core chip with plenty of grunt. And outside, you also get a decent array of ports, including USB-C, Gigabit Ethernet and an SD Card reader. Battery life here was likewise adequate – you should see about 3–4 hours for general use and watching videos, depending on how demanding the task you're doing is.

Our main gripe with the Helios is that, in Australia, it's difficult to find beyond the entry-level config, which comes with a 128GB SSD/1TB HDD combo for storage. While that HDD is arguably fine, we wish Acer had used a bigger SSD for that main OS drive – with Windows and your key apps installed, it doesn't leave much room for games, and installing them on the 1TB HDD will mean longer load times. Gigabyte's similar SabrePro (see *APC* 445, page 25) is another 15.6-inch gaming laptop with a GTX 1060, and while it may cost another $250 dollars, for storage, it includes a 256GB solid-state drive and a 2TB hard drive, which gives you significantly more headroom – and, if you can afford it, that makes it a worthy upgrade in our book.

Dan Gardiner

Verdict

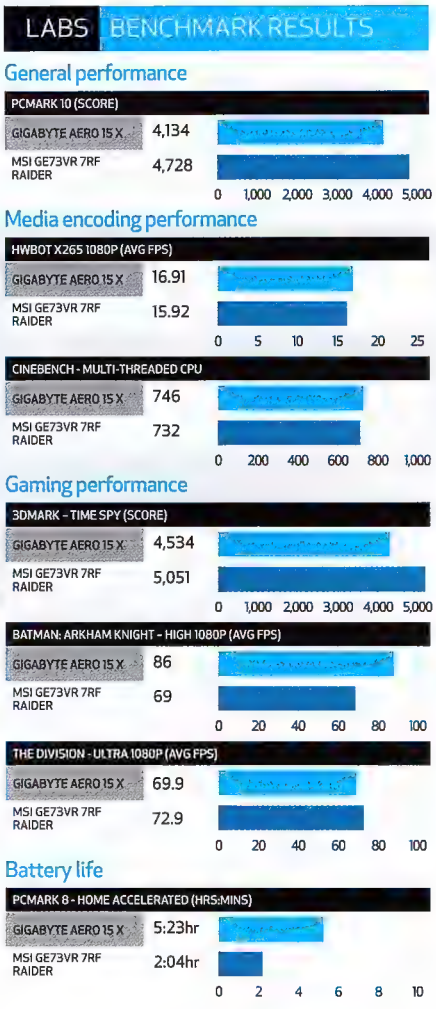
Features	★★★½☆
Performance	★★★★☆
Value	★★★★½

Offers great value for the specs on offer, but that small main SSD is a bit too limiting for our liking.

★★★★☆

GAMING LAPTOP

$3,199 | WWW.GIGABYTE.COM.AU



Gigabyte Aero 15 X

A sleek and speedy laptop that has both designers and gamers in mind.

Gigabyte makes laptops under a couple of different brand names, with those under the Aorus name generally leaning towards slick gaming units that are curvier and often have metal-clad chassis, whereas 'Gigabyte' models are often a bit bulkier and less-expensive.

This Aero 15 X could almost pass off as one of its Aorus siblings, however, as it's a super-sleek unit that's pitched at both designers and gamers. It's essentially a higher-end version of the Aero 15 that we tested earlier this year (see *APC* 443, page 19) and the key feature for designers is the display, a 15.6-inch number with a wafer-thin 5mm bezel – something that's allowed Gigabyte to squeeze it into a smaller 14-inch chassis, meaning it's impressively portable for a gaming-capable unit. But perhaps more critically, although it's only a TN panel, the screen's been factory-calibrated to match Pantone colour standards, so it's ready for colour-accurate design work out of the box... albeit not to quite the same wide colour palette as you'd get on an IPS display.

Gaming capabilities haven't been neglected either. Under the hood, that slim body packs in a cooling system that meets Nvidia's Max-Q requirements, which means that it's been able to one-up the earlier Aero 15's GeForce GTX 1060 GPU by squeezing in a GTX 1070 – a chip that's roughly 30–50% faster across the board.

And in both general and gaming performance, the Aero 15 X holds up very well – that cooling system is powerful enough that, in a couple of games, this unit comes close to matching ASUS's GTX 1080-sporting Zephyrus laptop – another recent slim-and-light that's equipped with Nvidia Max-Q cooling and GPU. Gigabyte has included good core hardware elsewhere, too, with a 512GB Samsung NVMe SSD for storage alongside a Core i7-7700HQ CPU and 16GB of DDR4 memory.

Moreover, despite that impressive performance and high-end specs, the Aero delivers one quite unexpected and trend-bucking perk: simply amazing battery life. Gigabyte has somehow squeezed a huge 94Wh battery inside the Aero 15 X's tiny chassis, allowing it to last between 5.5 to 8 hours in our tests – or around double the runtime of most other gaming laptops. With light use, this unit legitimately delivers 'all-day' battery life, something you don't really see in laptops with components this powerful.

In fact, the only thing we didn't like about the Aero was its trackpad. While it's nicely large, at higher sensitivities, it's harder to control than others. We had to slow it down for it to be usable, but ideally, you'll want to be using a mouse with this one.

It's also worth noting that this unit's 1080p screen is a standard 60Hz model, with no specific gaming features like G-Sync – that's the price you pay for its designer-oriented construction.

You can't quite have it all, then, but that doesn't mean this isn't a great unit that delivers in most of the areas it dips its toes in.

Dan Gardiner

Verdict

Features	★★★★½
Performance	★★★★½
Value	★★★★½

A sleek laptop that squeezes solid gaming chops, a classy 15.6-inch display and a lot of value into its 14-inch chassis.

★★★★½

apc RECOMMENDS

PROFESSIONAL MONITOR

$1,299 | WWW.ASUS.COM/AU

ASUS Designo MX34VQ

ASUS's latest pro screen ups the slickness ante.

Just when you thought ASUS's product offerings couldn't become more polished and consumer-friendly, along comes the Designo MX34VQ. It's an awfully long way from those frills-free circuit boards of old.

This Designo model feels like a carefully aimed headshot at the likes of Samsung's CF791. In fact, the MX34VQ shares several key specs with that Sammy screen. Both are 34-inch super-wide monitors with 3440x1440 native resolutions. They're both curved and both support 100Hz refresh and AMD's FreeSync tech. Then there's a very similar high-end consumer electronics feel to the both designs. But what really marks them out as peas from a similar pod is the use of VA as opposed to IPS panel technology.

Indeed, with ASUS reportedly sourcing its VA panel from none other than Samsung, you might suspect that they actually share the same panel. However, the Samsung screen sports a tighter 1500R radius to its curve versus ASUS's slightly less extreme 1800R bend. The other differentiator is Samsung's quantum dot technology boosting the fidelity of its backlight. Whatever, VA is always an intriguing choice due to the pros and cons it offers versus the ubiquity of IPS.

For starters, with VA, you get better outright contrast performance. In this case, a static contrast ratio of 3,000:1. IPS monitors tend to top out at 1,000:1. On the downside, VA panels don't offer the same super-wide viewing angles as IPS, and pixel response tends to be a little slower.

In practice, that's pretty much how it plays out. The MX34VQ has lovely, inky blacks, with very little evidence of light bleed. However, in its standard factory calibrated form, the MX34VQ also exhibits signs of crushing shadow details, which is a common trait in VA panels, and the flip side of that awesome contrast performance. In test animations, that characteristic VA inverse ghosting can also be seen, though it's much less of a problem in practical use. Likewise, there's no getting round the fact that the viewing angles aren't as broad as an IPS panel. Most of the time, that's fine. Just occasionally, however, you'll view images that are particularly sensitive to color shifts, and it will bug you just a bit.

That said, the 100Hz refresh makes for a lovely gaming experience. The high contrast and the rich if not quite quantum-dot-competitive colours make for a real spectacle in games such as Witcher III. OK, you don't quite get the same fluidity and sharpness of input response as a 144Hz or 240Hz monitor, but you do get most of the benefit of such screens versus a standard 60Hz monitor. Once you go high refresh, you won't want to go back, even for just shuffling windows around on the desktop – 60Hz suddenly looks so very old.

Elsewhere, ASUS has added a few nice extras, including Qi wireless charging in the base of the stand. That's very cool if you happen to have a phone that supports wireless charging. All, therefore, is largely well? Not quite. The MX34VQ's stand only supports tilt adjustment, it sits very low, and there's no VESA support to fall back on. Apart from that, it's a very appealing panel, albeit at a price.

Jeremy Laird

Verdict

Features	★★★★½
Performance	★★★★½
Value	★★★☆☆

Lots of lovely contrast; fab 100Hz refresh; awesome industrial design.

★★★★☆

GRAPHICS CARD

$1,099 | WWW.INNO3D.COM

Inno3D iChill GeForce GTX 1080 Ti X4 Ultra

A powerful GPU upgrade.

While it's possible to pick up a reference design GTX 1080 Ti from about a grand, the Inno3D X4 Ultra adds a factory overclock and chunky cooling for just $100 more.

The GPU's 3584 CUDA cores have had the base and boost clocks pushed up almost 10% to 1,607MHz and 1,721MHz, respectively. It also has 11GB of GDDR5X RAM, 6- and 8-pin power connectors, and on the business end, three DisplayPort 1.4, a single HDMI 2.0b and DVI. The subtly LED backlit, dual slot, 3+1 fan cooling solution means the GPU is slightly oversize, but will fit in most normal size cases without issue.

It should come as no surprise that performance is excellent, and at 1440p with maxed quality, we managed 101 frames per second in *GTA V*, 123fps in *Hitman* and a 3DMark FireStrike Extreme score of 14,189. Loaded up, the X4 draws up to 242 watts, but the cooling system has no trouble getting rid of the heat – even the small top fan moves a decent amount of hot air.

During low-key gaming, or when the card is not in active use, the fans come to a halt for added longevity and noise reduction. For those with plenty of case airflow, it's possible to extract a little extra overclocking performance from the Inno3D GPU – with a little tweaking, we could get about 5% higher frame rates when gaming.

The GPU is covered by a two-year warranty, which is a little disappointing compared to the three years from many of the similarly priced competition.

Lindsay Handmer

Verdict

A solid design and excellent performance while remaining on the more affordable end.

★★★★☆

WIRELESS MOUSE

$90 | WWW.LOGITECH.COM

Logitech MX Anywhere 2S

The best laptop mouse gets ever-so-fractionally better.

The Anywhere 2S is, in most regards, the same mouse as the Anywhere 2, just with an 'S' whacked on the end of a model name – something which denotes that it works with Logitech's Flow cross-computer control software.

The latter's an app which, when installed across multiple Windows or Mac devices, lets you use the same mouse (and, optionally, keyboard) to control them all. It's like a software-driven, cross-platform multi-monitor setup, and in practice, it's fairly seamless, just requiring you to move your mouse cursor onto the screen of the device you currently want to use. Of course, the caveat is that only certain Logitech devices are compatible.

The original Anywhere 2 has been our hands-down favourite laptop mouse since it was released two years back, and all that carries over to this new model. It's compact, tough-as-nails, very comfy and supports Bluetooth and Logitech's Unifying Receiver USB plug. Its tracking performance is nearly faultless and will track on just about any surface (even clear glass). We found the built-in lithium-polymer battery lasts for 2–3 weeks of daily use between charges, and it uses a USB micro-B cable to juice up and can continue to be used while doing so.

Given that the only major extra is Flow support, it's something of a niche upgrade – if you've already got the original Anywhere 2, then there's no benefit to jumping up to the 2S unless you really need that cross-device functionality. On the plus side, the 2S doesn't cost any more than its forebear.

Dan Gardiner

Verdict

If you need a good laptop mouse, this is the one to beat,.. if you don't already have the Anywhere 2..

★★★★★

apc RECOMMENDS

MECHANICAL KEYBOARD

$250 | WWW.DASKEYBOARD.COM

Das Keyboard 4 Professional

A mechanical keyboard that's not for gamers? Heresy!

Das Keyboard's original mission was building geek-oriented 'boards inspired by IBM's famous Model-M. All its boards now use some type of mechanical switch (most with the industry-standard Cherry MXs) and, bucking convention, its devices are aimed at keyboard warriors – programmers and typists, essentially – rather than gamers.

The 4 Professional is a sedate-but-sturdy model with a charcoal-black metal plate, and buyers can choose between Cherry MX Red, Blue or Brown switches. The only extras are the small bank of media controls at top right. There's no gaming bling to be seen – you won't find things like 16.7M-colour LED backlighting or macro-programmable keys and you don't have to install extra software to get full use of all its features.

It isn't without some controversial design decisions, however. Whether you're a gamer or not, backlighting is still a handy feature to have if you're in a dim environment, and after getting used to it on 'gaming' boards, we did miss it here. It also doesn't have riser feet – you can tilt the back of the board up, but this is done by adding or removing an included plastic ruler from a magnetised slot in the base, and the angle it gives isn't as steep as on most other boards.

If you can deal with those design choices, then this is a great 'board for those who find themselves doing a lot of typing. And for the uber-hardcore, there's also an Ultimate version which does away with any kind of stencilling on the keycaps – they're all blank, so any Dvorak converts will feel right at home. ■ Dan Gardiner

Verdict

Here, you get a super-reliable, stable and repeatable typing experience with no bling.

★★★★☆

apc HOT PRODUCT

MECHANICAL KEYBOARD

$125 | HYPERXGAMING.COM/EN

HyperX Alloy FPS Pro

This tenkeyless wonder is the refinement we've been after.

The Alloy FPS comes with a number pad, but the Pro iteration does away with this in favour of extra desk real estate for mouse-wielding.

Given its near-complete lack of framing or bezels, this makes for a 'board about as small as regular-sized keycaps will allow for. That compactness will aid in portability, something that's reinforced by a detachable USB cable, which is braided and sturdy, and the solid steel frame also lends to its impression of travel-ready ruggedness.

The aesthetic is quite striking thanks to the surface-mounted switches making the keycaps appear to hover over the innocuous metal frame. A lack of markings enhance this by leaving the base upon which the keys are mounted relatively untarnished. This simplicity is carried over into the backlighting, which has a small array of effects and brightness levels but is limited to the colour red.

As the name may suggest, this keyboard is targeted at the more 'basic' needs of FPS gamers and, as a result, doesn't support any macro recording or practically anything beyond the Game mode, which simply disables the Windows key.

Although this may dissuade fans of MMORPGs and other combo-heavy games, the upshot is that you won't need any dedicated software or even drivers to use all the FPS Pro's features – it's plug and play, baby.

And you get the same selection of Cherry MX switches as on the larger Alloy FPS and they're as satisfying as ever, whether you're into Red, Blue or Brown varieties. ■ Harry Domanski

Verdict

Refining the simplicity of an FPS keyboard by shedding anything unnecessary, including some cost.

★★★★½

$769 | WWW.MWAVE.COM.AU

Noblechairs Icon Series Real Leather Gaming Chair

A beautiful butt bucket.

How could anyone possibly say no when asked to review sitting down? It's second only to 'lying down' on my list of favourite things to do.

This large gaming chair comes partly assembled in the box and with the supplied instructions and – seasoned Ikeans will know what's coming – included Allen Key, it took us a leisurly 30 mins from unboxing to sitting. Noble recommends two people for construction, but this reviewer had no trouble flying solo.

The Icon's components are likewise top tier. The frame is steel, while the five-spoke wheel hub is aluminium. That's topped (or bottomed) off with supersized 60mm casters for zipping around on soft or hard-floor finishings.

The open-cell foam upholstery is forged from a cold-processing technique which is said to typically retain its form and be longer-lasting than traditional (and easier) heat-processing techniques. Skinning that with 'cognac' colour leather (there's also black and midnight blue/graphite options) and you've got one enviable gaming throne.

There are plenty of adjustment options packed in to customise the ride, too, with height and tilt free-swing packed into the bucket, and up, in, forward and back on the armrests. The latter sit low enough to slide under the desk for PC gaming and versatile enough to swing almost anywhere when kicking back with a gamepad in hand. Slide on the included neck pillow and lumbar support and you're good to go for hours on end.

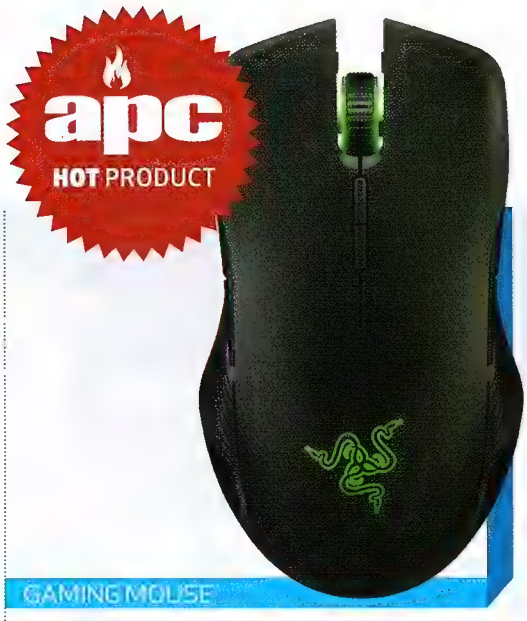
Really, calling this a 'gaming chair' is pigeon-holing: this is the Icon Series Real Leather Life Chair.

Troy Coleman

Verdict

A supremely comfortable, premium and robustly built gaming, office or life chair.

★★★★★



$250 | WWW.RAZERZONE.COM

Razer Lancehead

Razer goes back to the drawing board for its new flagship gaming mouse.

While wireless mousing tech might be shunned by pro gamers, for mere mortals who are willing to trade off wired performance for wireless convenience, there are plenty of options available.

We haven't been huge fans of Razer's previous wireless efforts. It's had one main offering for desktop use since 2009 – the right-handed Mamba – which has always suffered from fairly mediocre battery life and a clunky dock-to-charge system.

The Lancehead is shaped like a slightly less-curvy version of the DeathAdder (still our favourite wired mouse), this symmetrical design will suit both left- and right-handers, is nicely lightweight and evenly balanced and ditches the dock charger for simply plugging a braided cable in the front when needed. In testing, we got 5–6 days of use, about 30 hours, from a single charge.

The Lancehead faces pretty stiff competition from Logitech's G903. Claw- and palm-grip fans will prefer the Lancehead's bigger back end and more natural shape, while the G903's smaller, slimmer form is perfect for finger-tip users.

The downside to both these flagship mice is price: at $250 a pop, it's hard to really say that either is good value for money. Logitech's other wireless option, the G703, is $150 and provides near-identical performance to the G903, albeit without quite as many buttons or customisation options, and in a shape that's for right-handers only. For everyone but lefties, then, we know what we'd choose...

Dan Gardiner

Verdict

Impossible to fault from a performance or comfort perspective, but *oof*, that price.

★★★★½

apc RECOMMENDS

GAMING HEADSET

$169 | HYPERXGAMING.COM/EN

HyperX Cloud Alpha

A main-course of succulent sound with a side of innovation.

The Cloud Alpha headset from HyperX is a set of cans that *really* wants you to know it's intended for gaming, with an aesthetic that may embarrass the wearer on the streets. Despite the slightly gaudy appearance, though, the materials and construction are top notch, giving the impression of durability and offering plenty of cushioning for the head and ears.

The Alpha's included noise-cancelling mic is sturdy and works as it should, and the detachable braided cable is a nice touch, although the inline volume control is a little poorly designed – there's no indication of which way is up, as the control wheel protrudes from both sides.

The key feature that allegedly pushes the Alpha ahead of the pack is its 'dual chamber' drivers. These separate the bass from the treble and mid-frequencies in hopes of increasing distinction and doing away with distortion. While we found these chambers do deliver decent separation of the frequencies, distortion on HyperX cans has never been an issue for us, and in an A/B test with the older HyperX Cloud Revolver headset, the difference in audio profile was nuanced to say the least.

As a result, the Alpha is in an interesting place in the company's headset lineup. While there will likely be gamers that prefer the fit and aesthetic of the Alpha, the differences in sound are negligible unless you crank the volume to ear-splitting levels. Our recommendation is to pick the model that sits on your skull the best – the Alpha or similar Revolver. You won't be disappointed.

■ Harry Domanski

Verdict

Not especially groundbreaking, but any improvement is welcomed to this already stellar headset range.

★★★★☆

GAMING HEADSET

$209 | WWW.CORSAIR.COM

Corsair Void Pro RGB Wireless

Millions of colours, but it's the red battery indicator you'll see most...

There's plenty to like with the Void Pro RGB Wireless cans – decent, affordable sound, driven by 50mm drivers that don't distort at higher volumes, sensible controls, and a comfortable, adjustable fit.

The mic sounds about the same as it does in the old model: a bit quieter than most and lacking low-end, but featuring strong and precise noise-canceling. Improvements lie in the mic arm, however. It's a more flexible rubberised design this time, which can be positioned to fit, and there's a mute switch built in. We also like the red light on the mic to show it's muted. The memory foam earcups and padding on the headband are an unreserved improvement, though.

Running the RGB lights severely impacted the 12-hour battery life Corsair states in its specs – we got under five hours. Turning lighting off extended the battery life marginally over 12 hours. More annoying, the headset doesn't turn itself off after you shut your PC down.

The Dolby Headphone 7.1 digital surround is well implemented, but we still prefer to run them in stereo, though. There's a range of EQ presets to cycle through in there, too.

We encountered no problems with the wireless range, but you will always need the USB wireless receiver to use these cans. Moreover, mobile device cables are absent here, and we feel that lack keenly.

It's another competent offering, but it doesn't really deliver on its central idea: wireless RGB sound. If you don't care about lights, opt for a SteelSeries Arctis. If you do, choose a wired headset.

■ Phil Iwaniuk

Verdict

While this headset doesn't really deliver on all fronts, there's still plenty to like here.

★★★½☆

software

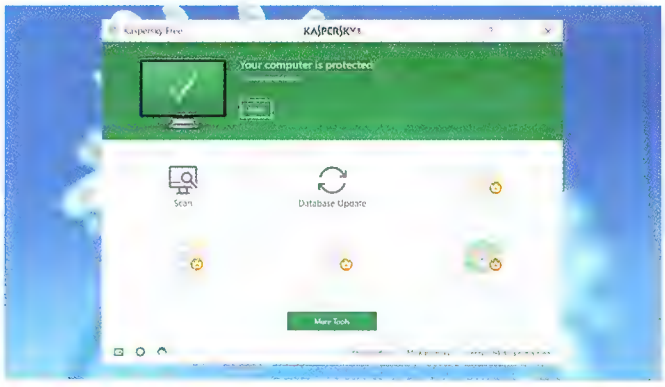
» APPS FOR ALL THE PLATFORMS

Windows SOFTWARE

Kaspersky Free

The Russian cybersecurity giant blasts into the free antivirus market.

FREE | WWW.KASPERSKY.COM.AU/FREE-ANTIVIRUS



Kaspersky Labs' security products have always had a great reputation for accuracy, but you've had to spend real money to get protected. Kaspersky Free changes the rules by making all the core Kaspersky technologies available for nothing, to both personal and business users.

The program covers all the antivirus essentials, including real-world scanning of files, web threats, emails and instant messages. Kaspersky Free has the same top-rated engine as the commercial builds, with the same update, self-defense and quarantine systems, and no stupid restrictions or nag screens to try and make you upgrade.

Unsurprisingly, the program leaves out a lot of Kaspersky technology. Top of the list is Safe Money, a secure environment for protecting your web shopping and banking tasks. There's also no System Watcher, which can roll back some malware actions, perhaps helping to recover files encrypted by unknown ransomware. Bonus extras like webcam protection and the anti-banner module have been dropped, and there's no technical support beyond what you can find on the website.

You also won't be able to cover these security holes by running Kaspersky Free alongside some other app. The installer will check for incompatible applications, just like any other Kaspersky product, and demand you remove anything that might cause problems (which is just about every other antivirus engine around).

Kaspersky Free has a clean and simple console which displays your current security status, and has simple icons to launch its various functions. Most of the options don't work in the free build, but they're greyed out and easy to ignore. Kaspersky Free doesn't skimp on scanning modes, letting you choose to search the full system for viruses or just the essential areas, external devices or specific files and folders. Scanning speeds are only average, but it doesn't grab too many system resources and is unlikely to slow you down.

Kaspersky Free is easy-to-use, with an excellent interface and top-rated virus protection. It doesn't have the power of its commercial cousin, but if you're happy with the antivirus fundamentals, Kaspersky Free will do a good job of keeping you safe.

Mike Williams

Hiri

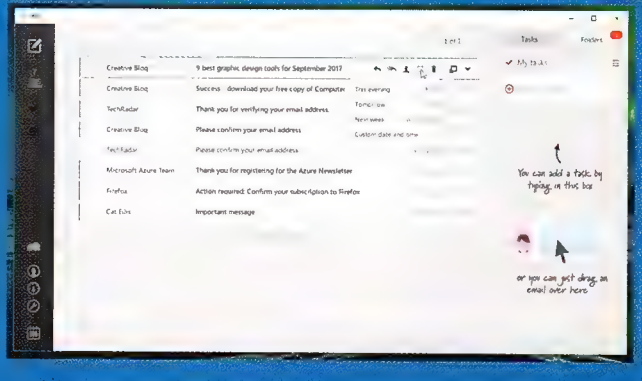
Master your messages.

14-DAY TRIAL, THEN US$29.25 PER YEAR | WWW.HIRI.COM

Hiri is an email client that aims to eliminate inbox inefficiencies with a dashboard view that tells you how many new messages you've received and how long you should wait before it becomes efficient to systematically tackle them.

When it's time to dive in, you're given a choice of two inbox views. The 'unified inbox' shows all messages regardless of their status, whereas the 'zero inbox' lets you drag emails into different folders (ideal if an empty inbox gives you a warm fuzzy feeling). [*It sure does! — Sub-Ed*]

Hiri uses 'Action' and 'FYI' fields instead of the usual 'To' and 'CC'. They essentially serve the same purpose, but if the recipient also uses Hiri, the email will land in a dedicated inbox so they can see immediately if a message needs active attention.



You can also add tasks to emails, which is far more convenient than using a separate task-management tool like Trello and the email client even uses it's own calendar. Hiri is currently available for Microsoft email services (like Outlook, Hotmail and Exchange), with support for Gmail reportedly coming later this year. **Cat Ellis**

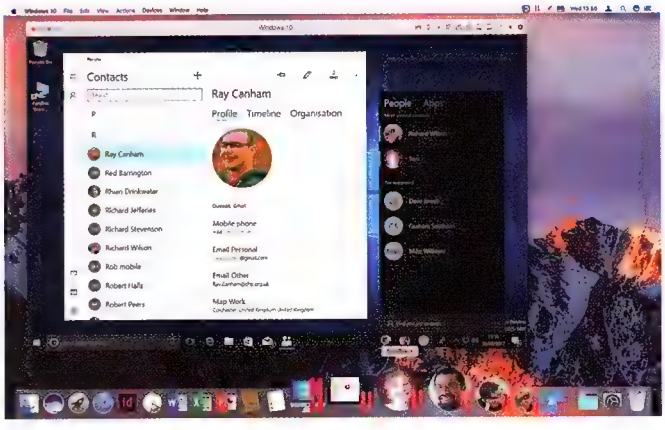
Parallels Desktop 13

Run virtual Windows machines on your Mac.

$99.95 | PARALLELS.COM

When it comes to running virtual versions of Windows, Linux and even older iterations of macOS or OS X, Parallels Desktop is king. It's well made, easy to use and manages to blend virtual machines (VMs) into your Mac desktop with features like Coherence mode, which enables you to run Windows apps in their own windows as if they were native. Parallels' problem is that it's so mature it's hard to justify an upgrade every 12 months, with version 13 feeling more of a point release than a major new version.

Its main highlight is support for the MacBook Pro's Touch Bar inside your Windows virtual machines. This feature is context-sensitive, supporting major apps, as well as replicating the shortcut icons from the Windows Taskbar, and there are limited customisation options for incorporating other programs, too. Parallels can also incorporate Windows features into your Mac desktop. As well as existing integration of Cortana, version 13 adds support for Windows 10's new People Bar, which lets you pin favourite contacts to the Taskbar. Parallels extends that to the Dock while your VM is running. Aside from a design refresh, the only other feature of note is the Picture-in-Picture view, which lets you minimise all open VM windows to thumbnail images.



These float on top of other windows and update in real time. There are also the usual performance tweaks, plus improved rendering of scaled VM windows on Retina displays.

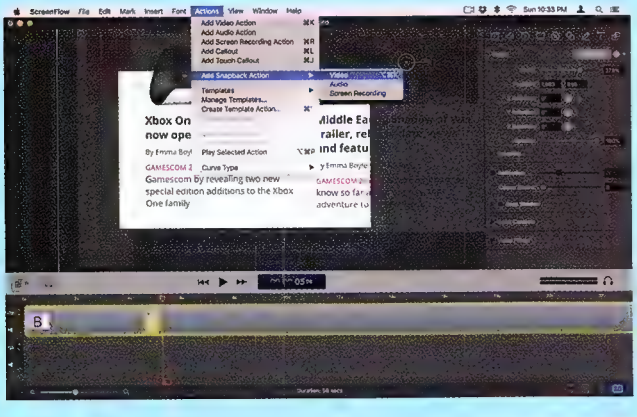
If you're looking for a more flexible and powerful alternative to VirtualBox, this is a no-brainer. But unless you have a Touch Bar, there's little reason to upgrade from last year's release. **Nick Peers**

Screenflow 7

Record and edit on-screen action from a Mac or iOS device.

$199.99 | TELESTREAM.NET

If you need to record your Mac's screen there are several options available, including, albeit at a very basic level, the built-in QuickTime Player. The maker of ScreenFlow 7 is hoping that the additions to this version will tempt you to choose it over competitors like Camtasia. Among those new features are tools for animating text, customising keyboard shortcuts, and several new export options. Also new is the Global Library, where you can store assets like video and audio clips. ScreenFlow can also grab video and audio from FaceTime, an external webcam, or an iPhone or iPad. Once you have all the clips you need, editing them is easy.



In terms of controls, if you've used other video editing tools, you'll be familiar with both the conventions and their shortcuts. Callouts can be added to mimic either mouse actions on a Mac or touch-based interactions on an iOS device's screen. You can also draw them onto clips freehand to highlight areas or blur out sensitive details. And you can add annotations. Text is added on a separate layer and can be styled using fonts on your Mac, as well as by building in and out transitions and adding a backdrop.

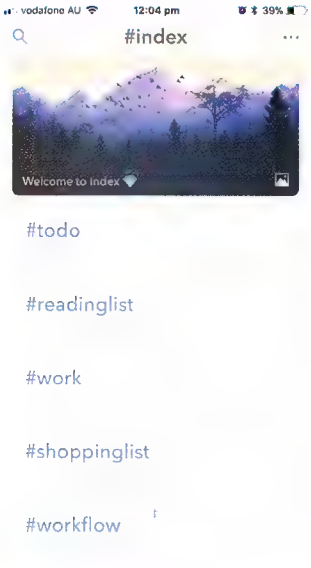
Actions, where you can animate sections of a recording, have been around for a while, but in version 7, they can now 'snap back' to their original state with one command. Actions can also be turned into templates and reused.

ScreenFlow has a great deal to offer, from casual users to those who spend a large chunk of their working life making screen videos. Its interface is clear and well presented, but we found some features (like snapback actions) difficult to use, even after watching tutorial videos. That aside, ScreenFlow 7 is an excellent update to a terrific app. **Kenny Hemphill**

Index

Increase productivity by indexing your schlerf.

FREE WITH IAP | INDEXAPP.COM



Admittedly, there are plenty of productivity apps out there, but Index brings your entire world, and the world outside, together in one very neat spot, with all your saved items accessible from any device – Index is available for iOS, Android, Chrome, Firefox and a web platform.

You will need to create an account. Your schlerf gets saved within a system of hashtags that you can create, and sort through it all using 'slash commands', which, unfortunately, are currently set in stone. The devs plan to let users create new commands and add collaborations in future updates.

With Index, you can save not just notes, but web pages, web searches, photos and even store your Dropbox or Google Drive files. Heck, you can even do a Google search when trying to find a link to something right in Index. This brand-spanking new app does take a while to get used to, but once you're up and running, we don't think you'll need another productivity app. Index is free to use until you've saved 237 files, after which you'll need to pay $2.99 a month to keep you life organised. **Sharmishta Sarkar**

Pixel

Learn to program your very own robot.

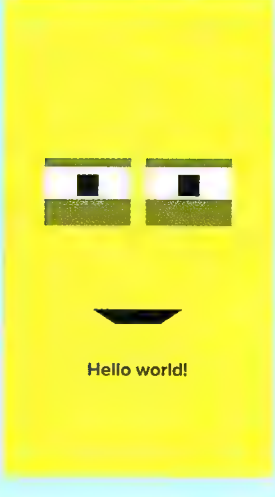
FREE | ROBOTPLAYTIME.COM

Say hello to Pixel, the little emotionless, unintelligible robot that can evolve if you can program him to be better. This interactive robot begins life on your iPhone or iPad with a neutral, rather boring face and you can add emotions, expressions and words to his repertoire. Programming the robot is dead simple — the app uses easy-to-understand drag-and-drop blocks based on the programming language Scratch. This is a great start for anyone wanting to understand the basics of robotics. In fact, it's a wonderful tool for primary schools to encourage kids to study computer science.

When programming Pixel, remember to hit the green flag when you're happy with the workflow. That will take the screen back to Pixel and animate him to do whatever it is you want him to do. It's an excellent way to learn programming, based on trial and error. Something didn't work? Just try another set of blocks.

Pixel isn't just for kids — no matter how old you are, it's never too late to learn how to code.

Sharmishta Sarkar



Home 3

More than keeping up with the Joneses.

$22.99 | HOCHGATTERER.COM

iOS 11's improvements to HomeKit are available to third-party apps as well, enabling them to provide alternative ways to manage your smart home that are arguably less confusing to use than Apple's own Home app, which makes extensive use of long/firm presses to reach accessory settings.This alternative shows accessories in tappable rows, and uses equally conventional controls, such as sliders, to adjust settings.

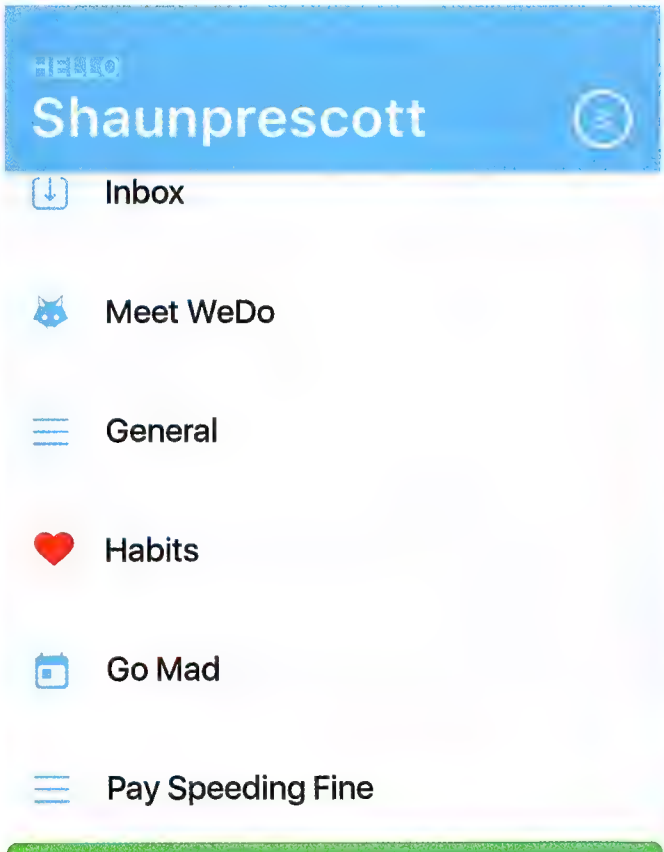
It's a matter of taste whether this or Apple's larger controls are better; though the latter can seem fussy, they're arguably quicker to use. If you have more than a handful of accessories in your setup, Home 3's colour-coded icons next to accessory names guides your eyes faster than the large tiles used in Apple's app. Home 3 can lack clarity, though. The tab that shows an overview of all your accessories doesn't list their rooms — renaming helps, but shouldn't be necessary

Home 3's automation features stand out. Compact presentation is again beneficial, and you can do more than in Apple's app; where that doesn't allow us to create automations triggered by our temperature sensor, Home 3 does. What holds us back from awarding more praise, though, is Elgato's free Eve HomeKit management app, which offers similarly welcome simplicity and access to extra triggers for your automations.

This is a capable alternative to Apple's eponymous app, but similar and free alternatives exist.

Alan Stonebridge

Google Play » ANDROID



WeDo

A slick, easy-to-use reminder app.

FREE | WEDO.COM

Described (by its creators) as "your second brain", WeDo is a neat little productivity app neither bloated nor lacking crucial features. With a handful of categories pre-built in, it's all about adding categories, populating them with stuff that needs to be done or remembered, and then enjoying the thrill of marking these things as 'done'.

There's calendar functionality as well, so you can create events and reminders, and then, with the swipe of a finger, gain a broad overview of how your day's looking. It's not exactly nuclear science for a productivity app to also boast list-making features, but that's arguably our favourite part of WeDo – that the same app that reminds us there's a work function on also tells us what we need to pick up at the supermarket on the way home.

And yet, WeDo has a nice streamlined feel to it that is a pleasure to navigate. Definitely a good contender for productivity all-rounder. **Shaun Prescott**

Safer Journeys

Curbing the road toll.

FREE | SAFERJOURNEYS.COM.AU

It's come to this: NRMA, one of the nation's motor vehicle insurers and road-side assistance companies, is now offering people money to not use their phones while driving. It seems that not being fined and also not being distracted while driving and potentially killing someone isn't enough motivation.

Taking our grumpy hats off for a moment, the upshot is it's potentially free money for not breaking the law! Link the app to your Facebook account (there is no other way to log in and use it, sadly), and hit Start when you begin your journey. Every minute of undistracted driving earns a point, and every 10 points earns an entry into a daily prize draw. You need to keep the app open for the whole trip, which means no GPS, no music controls, but also no Facebook, replying to SMS and other distractions. Your screen is blacked out, apart from a feint outline of a stop button. Try to side-load an app and you'll be booted out, with a sad message when you go back in and points docked off your total.

Paul Taylor

Clockwise

Functionally punctual.

FREE WITH IAP | WWW.YOURSMARTALARM.COM

Waking up to the same stock alarm sound every morning can wear you down, but Clockwise has an interesting approach by offering you fresh information when it's time to rise.

Everything you'd expect in an alarm app is here — specific day and date selection, recurring alarms — and it is presented in an incredibly tidy fashion. This app's point of separation is in its modules and their extreme customisability. Each module offers something useful, such as the local weather, event reminders or to-do lists, or something novel, like a quote of the day, fun fact or top Reddit post. These are all read to you in a voice of your choosing (including Australian male or female options) and although you can have as many as you want in the paid version, the free app limits you to three modules per alarm.

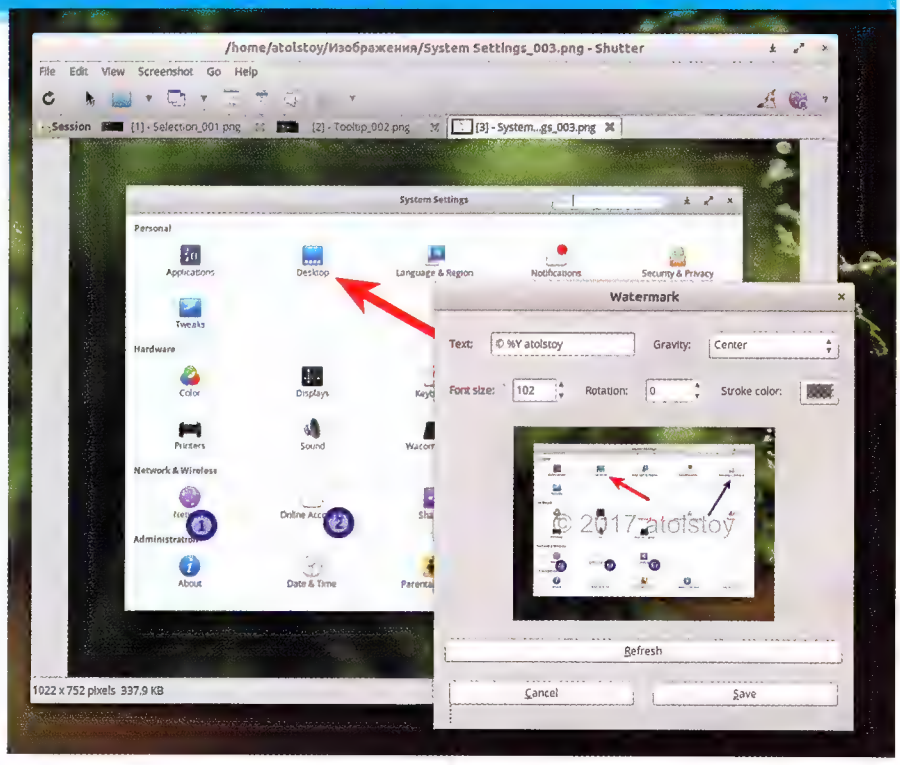
Clockwise offers an incredibly impressive degree of control, from variable snooze times or delay before the modules kick in, to being able to snooze the alarm via a hand gesture or getting the alarm to wake you up early if your area's going to experience rough weather (and you therefore need to factor in extra travel time).

Harry Domanski

Shutter

Ditch The Gimp!

FREE | WWW.SHUTTER-PROJECT.ORG



Shutter is theLinux program that you should launch instead of The Gimp if you want to label something on a screenshot, or obscure some details within it that you'd rather not make public. It's perhaps the smartest and the most fully featured screenshot tool available on Linux.

Shutter hadn't seen any updates since 2014, so the new version is a pleasant surprise. However, there aren't too many changes, apart from a few fixes that improves its stability when exporting images to Imgur and Dropbox. But what's got us really interested is the number of useful editing tools for annotating images.

The main window is normally empty – waiting for you to take a screenshot. Select the appropriate icon on the toolbar for taking either a snapshot of the entire desktop, a specific window or a particular area of your screen. In a couple of seconds, the image will appear. Right-click it and select Edit to transfer it into the dedicated editor window. Here, you can add arrows, lines, shapes, text labels, auto-numbered circles, and also highlight certain parts or remove sensitive information.

The feature set of Shutter's editor is pretty comprehensive and includes most tools that we commonly use in simple Paint-like programs. When you've finished editing, save your results and close the window – Shutter will display the altered version of the screenshot in its main window.

You can also apply various creative effects by selecting 'Run a Plugin...' from the Context menu. Shutter comes with a decent set of effects, such as watermark, sepia, Polaroid, autocrop and more. You can customise and adjust most of the effects. Finally, save your work as a PNG image, or export it to an FTP server, or a cloud service.

Overall, Shutter a powerful all-in-one solution for managing your screenshots. It's definitely worth giving the program a – ahem – shot! **Alexander Tolstoy**

Focuswriter

Plain and Pomodoro!

FREE | WWW.GOTTCODE.ORG/FOCUSWRITER

At first glance, Focuswriter didn't look too promising: it was a text editor with a fullscreen mode by default and no visible controls. But we were completely wrong once we tried to write something. It creates magic out of nowhere, thanks to its zero-distraction approach. Once you launch the app, just start typing your thoughts or ideas. Under the hood, Focuswriter has all necessary means for text formatting and also some productivity tools. Start by making your text bold (Ctrl-B), underlined (Ctrl-U) or italic (Ctrl-I), proceed with aligning a paragraph using Ctrl plus { , | or }, and don't forget about finding (Ctrl-F) and replacing (Ctrl-R). Exploring the app's menu that shows up on mouse hover revealed more great features, such as picturesque themes, optional typewriter sounds and a great alarm tool. Set a period of time that you wish to write for, select a stylish layout and start working before a notification pops up to inform you that it's time to take a break. If you're fond of non-distractive writing, you'll find Focuswriter very useful. **Alexander Tolstoy**

Moneyguru

Manage your moolah.

FREE | BIT.LY/2WUCU9L

By default, Moneyguru has six horizontal tabs for exploring net worth, profits and losses, transactions and also scheduling transfers and keeping a budget. The app uses a double-entry accounting approach, meaning each transaction is recorded twice: for assets and liabilities — a conventional accounting practice. You can start recording your money flow by creating an account inside the Assets or the Liabilities category on the Net worth tab — just select a category and press the + button in the lower-left corner. Double-click the account name and you'll find yourself on the separate tab for that account. Moneyguru automatically updates the Net worth view and draws a clear graph in the lower part of the window, which indicates your flow. The software is quick and fairly simple to use once you've got the hang of it. Launching Moneyguru requires the python-qt5 package on your system. Once you have it installed, run `$ make && make run` in the main tree directory to fire up the main window. **Alexander Tolstoy**

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TP-Link and D-Link routers support PPTP VPNs as a client, so you can permanently connect them to a VPN.

Specialised routers under the microscope

A new range of high-security and specialised 'family' routers promise to do more than their common counterparts — so do they? Nathan Taylor tests four models to find out.

Without question, stock router firmware has improved dramatically over the years. The days of needing to understand the intricacies of PPPoE or knowing whether to use WPA or WEP wireless security are well behind us. There are simple mobile apps to help us along the way, and the quality of the administration interfaces has improved a lot.

But we're not all the way there yet. If you want to permanently connect your network to a VPN in order to protect your data from snoops, you'll still need a special router. A lot of other features found in corporate networks still aren't available to cheaper routers, either, even though the existence of open firmware like DD-WRT proves that there's no reason that they can't be. Instead, you have to fork over extra money for a so-called 'security router'.

So this month, we first decided to look at a couple of security routers that won't break the bank. They are stock consumer routers that have been flashed with more capable firmware, so you get all of the features of an open firmware out of the box.

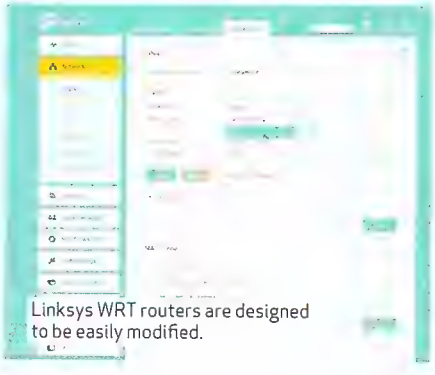
After that, we'll take a look at a different kind of security device – one focused on families. These routers are built around the idea of protecting children from net nasties and go far beyond the basic parental controls built into most routers.

OTHER OPTIONS FOR VPN ROUTERS

It used to be the case that a security router was a special thing, worthy of tacking an extra few hundred dollars on the price tag. However, ever since open firmware proved that you can make a security router using cheap consumer hardware, other router vendors have bitten the bullet and said, "Sure, we can do that too."

If you're looking for security, particularly VPN client support, in an affordable router, we'd recommend: ASUS routers.

If you want a router that does the kinds of things that DD-WRT does out of the box, then your first port of call should be ASUS. A few years ago, the company stopped using custom firmware in its router range and instead built a version of OpenWRT for its routers. And it has paid off.



Linksys WRT routers are designed to be easily modified.

It's the best firmware around, with both a consumer-friendly patina and accessible mobile apps, as well as the deep feature set that we've come to expect from WRT-based firmware. In short, ASUS routers offer the best of both worlds: they're easy to use but still offer VPN support, VLAN, complex QoS and much more.

TP-Link routers don't really qualify as security routers and can't operate as VPN servers, but most models do let you set the internet connection type to PPTP/L2TP. That means you can connect them to a VPN service as a client, which may be all you're looking for.

Likewise, in many D-Link models, you can set the internet connection type to PPTP/L2TP.

Draytek routers nearly all support VPNs to some extent, and have other advanced security features like content controls. They tend to be more expensive than the average consumer router, however.

Linksys' stock firmware does not support VPNs. But its range of WRT routers, such as the WRT1900ACS, are designed to be easily modified with third-party firmware. They're very easy to upgrade to DD-WRT, and some VPN providers like ExpressVPN even provide a custom firmware build for the WRT routers to simplify connections.

Wireless: 866Mbps AC + 300Mbps N; WAN ports: 1 x Gigabit port; LAN ports: 4 x Gigabit ports; USB: 1 x USB 2.0, 1 x USB 3.0; Firmware: DD-WRT

US$250 PLUS SHIPPING | WWW.FLASHROUTERS.COM

Linksys WRT1200AC DD-WRT FlashRouter

Is it worth the premium price?

A pre-flashed router is a standard consumer broadband router flashed to order, pre-configured to connect to a VPN service of your choosing.

The price for having the router pre-flashed is very high. The stock Linksys WRT1200AC retails for $240 in Australia, but to buy it from FlashRouters costs about $315, plus a shipping cost of about $90, which makes it a very expensive upgrade. Given that the WRT1200AC is one of the easiest routers to flash yourself, we doubt too many people will be willing to fork over the extra money.

Cost aside, it's a nice, mid-range broadband router. There's nothing here particularly special or out of the ordinary. It's just an 802.11AC router that supports 866Mbps 2x2 MIMO and four Gigabit Ethernet ports. It runs on a dual-core 1.3GHz processor with 512MB of memory. It comes flashed with the DD-WRT mega firmware, which has all the features available to DD-WRT. That includes support for VPN client and server with PPTP, OpenVPN, VLAN tagging, SNMP management and all the other features common to the WRT-based firmware.

Its biggest selling point is unquestionably that it comes pre-configured for a particular VPN provider. If you give FlashRouters your VPN username and password at the point of sale, the whole operation becomes plug and play, without you ever having to go into the admin console.

But for Australian users, it's a hell of a premium to pay for something that's not really that hard to do yourself, especially with this router model.

Verdict

Having a pre-flashed router is convenient, but the price premium on this one is too much.

Wireless: 1,300Mbps AC + 600Mbps N; WAN ports: 1 x Gigabit port; LAN ports: 4 x Gigabit ports; USB: 1 x USB 2.0, 1 x USB 3.0; Firmware: DD-WRT

US$320 PLUS SHIPPING | WWW.FLASHROUTERS.COM

Netgear Nighthawk R7000 Tomato FlashRouter

How does Tomato do?

The R7000 Tomato FlashRouter is another mid-range router model that comes pre-flashed with WRT firmware. In this case, instead of using DD-WRT, it comes flashed with Tomato. Tomato has a similar set of features to DD-WRT, but it's arguably more consumer-friendly.

Like DD-WRT, Tomato lets you use the router as both a VPN client and server. If you have an existing VPN service, you can provide the details to FlashRouters when you buy the router. It will set everything up for you, and all your data will automatically be routed through the VPN service.

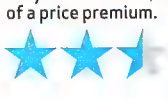
The highlight of this particular router, however, is that, if you like, you can specify that certain devices, websites or apps should bypass the VPN. That way, if you need maximum speed and responsiveness (for gaming or VoIP, for example), you can skip the VPN and connect to the internet directly. It's a feature we've seen on some recent ASUS router models, and a major boon to gamers who want everything secured but want their game traffic to have as little lag as possible.

The hardware in the Netgear is merely mid-range – it's an older model router, offering wireless AC1900 and four Gigabit ports along with two USB ports.

Much as with the Linksys, price is going to be an issue for most. An unflashed R7000 costs about $250 at retail in Australia, but FlashRouters is asking for US$320, plus shipping. You're looking at nearly double the Australian retail cost. That kind of premium will no doubt make flashing the router yourself look rather appealing.

Verdict

It's nice to have everything done for you in advance, but that's a hell of a price premium.



FAMILY ROUTERS

Wireless: 866Mbps AC + 300Mbps N;
WAN ports: 1 x Gigabit Ethernet uplink (WAN) port;
LAN ports: 4 x Gigabit ports; USB: 1 x USB 2.0

$89 PLUS $5.95 PER MONTH | WWW.FAMILYZONE.COM/AU

Family Zone Box

Parental controls without needing local software.

The Family Zone Box is a new kind of device designed specifically for filtering adult content and managing access to certain apps and social media services. Although it's technically a router, it's not really designed to operate as your primary internet connection device. Instead, it plugs into the back of your existing router and creates an independent Wi-Fi network and LAN.

Any device that connects to this network is managed according to rules you configure. Configuring rules is managed through a web portal, where you set access times, restricted sites, blocked services and so on for each user. Compared to the KoalaSafe (right), the process is a little arcane, but it gives some quite powerful tools for restricting access to sites and social media.

Once you're done, plug the Box into your router and register it to your account. It creates its own independent Wi-Fi network. One by one, you connect and register your devices and associate them with an owner, and that owner's access rules are then applied to that device.

While we prefer the simplicity of the KoalaSafe, the Family Zone Box gives the kind of powerful controls over access that would normally require locally installed software. It's harder to bypass, and it works for every device in your home without you needing to install anything.

However, it's a subscription service, and its mobile app is a little rough around the edges. Still, the hardware is solid, the filtering really works and it has more powerful wireless and more LAN ports for wired devices than the KoalaSafe.

Verdict

It's a little complicated to set up, but provides better protection than regular broadband routers.

★★★½☆

Wireless: 150Mbps N; WAN ports: 1 x Ethernet;
LAN ports: 1 x port; USB: none

$125 | WWW.KOALASAFE.COM

KoalaSafe

Comprehensive parental controls for a one-off payment.

Although it works on largely the same principals as the Family Zone Box (right), the tiny little KoalaSafe is made for everybody and boils it right down to the basics.

The KoalaSafe also creates its own independent Wi-Fi network. Shut off your existing Wi-Fi network (or at least change the password so the kids can't access it) and have every device connect to the KoalaSafe Wi-Fi. The KoalaSafe then applies parental control rules configured for individual devices.

The KoalaSafe box plugs into a LAN port on your existing router, and it's entirely managed through a mobile app. We were big fans of the app – it gave us easy access to the all the tools we might want: access controls and site restrictions, activity reports, immediate 'internet off' buttons... It's intuitive and easy to set up profiles for individual users so that each person in the house gets their own set of rules.

This simplicity and the fact that getting the app involves a one-off payment with no subscription are major plusses. It updates its filtering categories automatically, and its setup and management are straightforward and accessible.

What's not so great is the hardware. It only supports 150Mbps 802.11n and has a single LAN port. Compared to the Family Zone Box, that's pretty outdated Wi-Fi, and we found the range of the box pretty poor. At 15m, we started experiencing connectivity dropouts.

Weak Wi-Fi aside, however, this is a well-designed product.

Verdict

A neat little tool with a great mobile app to control it. It's only let down by weak wireless.

★★★½☆

DIY super-router: Setting up DD-WRT

Nathan Taylor explains how to turn a cheap router into a fully-functional high-security device.

What's the difference between a $150 broadband router and an $800 'security' router? The answer, as often as not, is "nothing". Or at least when it comes to the hardware. What makes a router a 'security router' is the software installed on it – the support for VPNs, content management, VLANs, advanced bandwidth reporting and quality of service, RADIUS authentication support, SNMP management and USB 3G/LTE support. All those things are implemented in software, and you can have them on your inexpensive router just by updating your firmware.

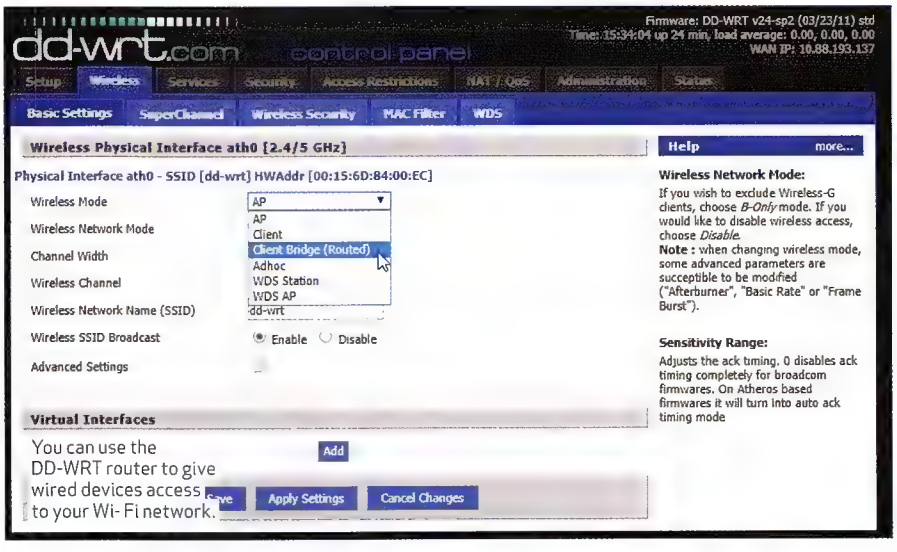
The firmware in question is not stock stuff. Instead, it's open-source firmware that's designed to completely replace that which came built into your router. Installing it will completely change the router interface. Your router management mobile apps will no longer work. The web address you use to manage the router may change. And in a lot of cases, management of the router will become more technical. That's the price you will pay for adding a whole host of new features to your inexpensive router.

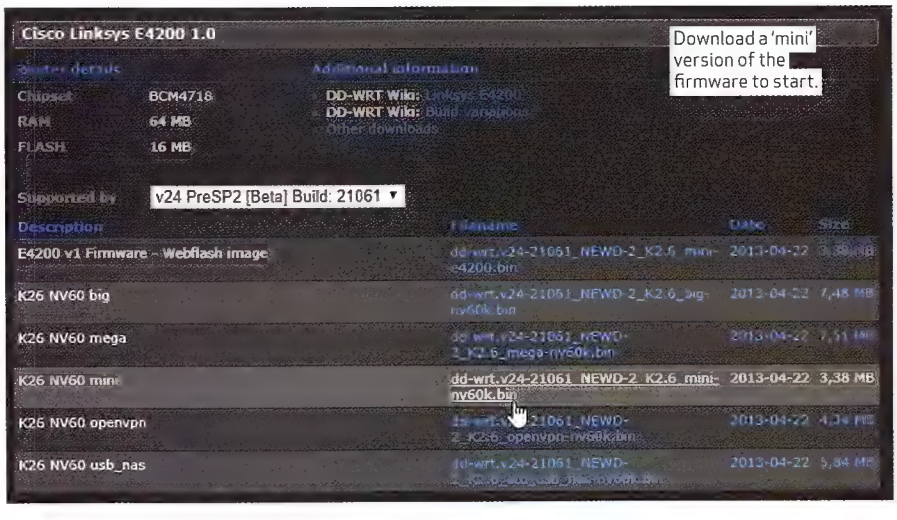
WHAT IS THIS FANCY NEW FIRMWARE?

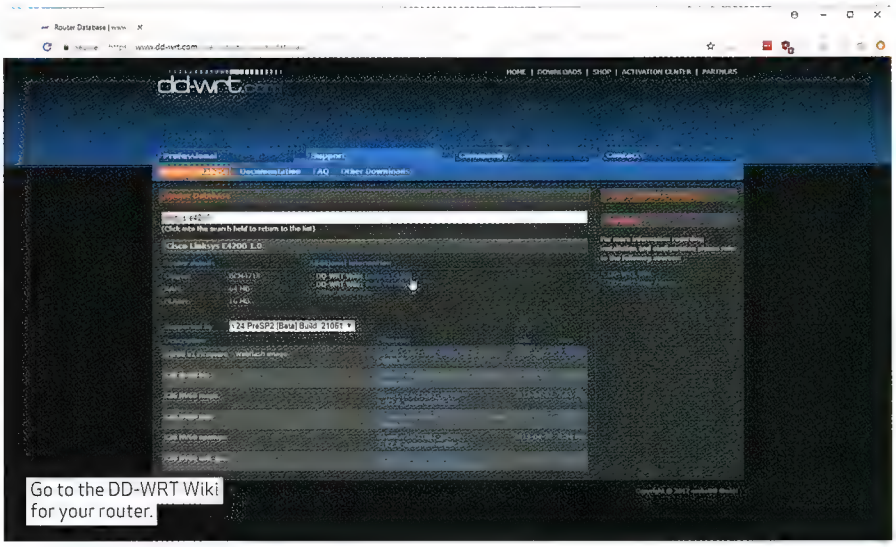
It's actually pretty old. Back in 2002, Linksys released the now-famous WRT54G router. What made this router different was that it didn't use proprietary firmware like most routers. Instead, it used a customised version of Linux. Although Linksys would eventually cancel the line, the open-source firmware was out there, and various other groups took it and continued to develop it. They made it work on other routers, which was easy since most routers use the same or similar hardware.

The most famous offshoot is DD-WRT (**www.dd-wrt.com**), a firmware that offers a host of advanced configuration tools to users, including many that were previously only available in expensive security and business routers. For consumers, a huge addition was the support for VPNs – if you want to route

The original WRT54G.







Go to the DD-WRT Wiki for your router.

The main DD-WRT interface.

all your internet traffic over a VPN service, you can. DD-WRT also has no limits on the number of VPN tunnels – run as many as your router will support.

CAN I INSTALL IT ON MY ROUTER?

DD-WRT is available for a huge number of broadband router models, since those tend to use standard production processors. It's not available for DSL modem routers. To check if your broadband router is supported, head to **www.dd-wrt.com/site/support/router-database**. There, you can type in your router model, and it will report if the model is supported and provide links to setup guides.

HOW TO INSTALL DD-WRT

Here's where things can get tricky. We can't provide a universal guide here, because there is no universal guide. On some routers, it's as easy as going to the firmware update page and clicking on the update button. On other routers, you have to first perform factory resets or go through certain rituals in order to install DD-WRT. In general, though, you'd follow these steps:

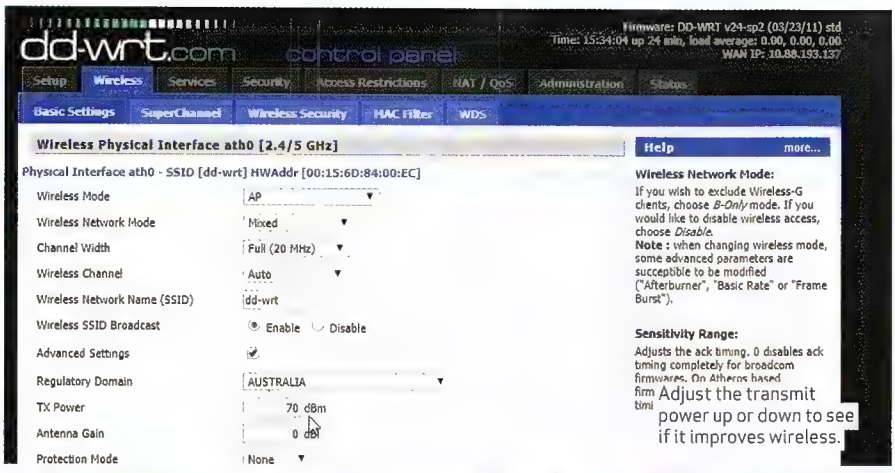
- Perform the search on the DD-WRT site for your router model as above.
- If you see your router model, click on it. You'll see an information page for that router and a list of the most recent versions of the firmware.

What DD-WRT offers over stock firmware

A quick look at the popular open-source firmware's key extras.

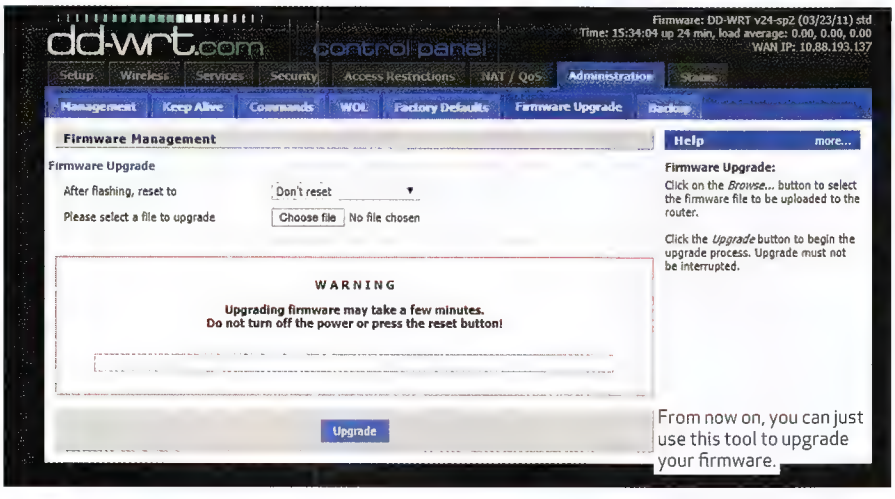
- VPN client and server support with unlimited tunnels
- USB 3G/LTE modem support
- Bandwidth usage graphing and logging
- Wireless transmission power adjustment
- Complex quality of service and access restrictions based on app or user
- SNMP device management and RADIUS user authentication
- VLAN segmentation, allowing you to creating multiple independent LANs on the one router
- ChilliSpot, Sputnik, HotSpot and NoCatSplash support — these allow web-authenticated guest access to Wi-Fi with a landing page (for, say, a coffee shop or motel that wants to give guests access but not just have an open Wi-Fi network)
- MilkFish SIP support for IP telephones (allowing you to run a simple IP PBX)

- You probably see that there are various versions available, labelled with things like 'big', 'mega', 'mini' and so on. DD-WRT has different firmware releases with different feature sets. The mini release is a bare-bones release, while the mega release is the burger with the lot.
- Click on either the 'mini' release or 'webflash image' if they're available. This is a good place to start. You can always upgrade to a heavier version of the firmware later if you need some feature that's not available in the mini version. This will download a .bin file to your PC.
- Now to go to the guide for your particular router. There will be a link to the DD-WRT Wiki on the router page. Click on it.
- The guide will walk you through setting up the firmware on your router model. It will most likely start with a 30/30/30 hard reset. This means that (with the router power on) you press and hold the reset button for 30 seconds; then (still holding the button) you turn off the power for 30 seconds; then (again, still holding the button) you turn it back on and wait 30 more seconds. That should return the router to its factory state.
- After that, you may be able to use the web admin firmware update, if you're



Adjust the transmit power up or down to see if it improves wireless.

DD-WRT supports PPTP and OpenVPN as both client and server.



From now on, you can just use this tool to upgrade your firmware.

DD-WRT demo

Try before you flash with an online demo of the DD-WRT interface.

If you're worried that DD-WRT might be too complex for you, then you can always try before you buy. Head to **www.dd-wrt.com/demo**. A dummy interface that you can play around in has been set up, showing you all the features of the firmware. If it all seems too technical, then it's best not to try it.

lucky. If you're not, you may have to issue Telnet commands or jump through other hoops to upgrade.

- Once you've updated the firmware, you can log onto the admin interface of your new DD-WRT router. In your web browser, go to 192.168.1.1 (the default IP address of DD-WRT). Log in with the default username and password: admin/admin. You should see the DD-WRT interface.
- Now that you have it running, you can upgrade to a more feature-rich version of DD-WRT. Go back to the database on **dd-wrt.com**. You can download a 'vpn', 'big' or 'mega' version of the firmware. (If you want to know what's in each version, click on the Build variations link).
- In DD-WRT on your router, go to 'Administration > Firmware Upgrade'. Click on 'Choose file' to select the .bin file you just downloaded, then click on Upgrade. You don't have to go through any rituals or hard resets: from now on, you can upgrade DD-WRT using the web upgrade tool.

THINGS YOU CAN DO WITH DD-WRT

Although it's more powerful, you'll likely find that DD-WRT is more complex than most consumer firmwares. It tends to use technical terms and doesn't do a lot of hand-holding. Some highlights include:

VPN support (assuming you're running a version of DD-WRT that has VPN). Find it under 'Services > VPN'.

Wireless transmit power controls. Go to 'Wireless > Basic Settings' and click on the Advanced Settings box. You'll see some advanced configuration options for wireless, one of which is Tx power, with a figure listed in dBm. If you're struggling with wireless reception, you can increase or decrease this, up to 251. It's important to note that higher is not necessarily mean better; it increases noise and can cause your router to overheat. Many get better results by going lower than the default.

Set the wireless mode to client bridge (turning the router into a wireless-to-wired adapter) or WDS repeater (so the router functions as a repeater). You can find it in the Wireless Basic Settings.

You can set internet access times and block or limit certain services, and prioritise data based on application or user. Head to the Access Restrictions and NAT/QoS tabs to find the settings.

There's a lot more you can do, and it's absolutely worth exploring DD-WRT's capabilities. Before you know it, you'll be making a home IP PBX or using it to provide guest access to Wi-Fi in your place of business. ■

Other open firmware

DD-WRT is not the only spin-off from the original WRT firmware. Some others include:

- OpenWRT (**openwrt.org**) is more of a toolkit than a packaged firmware. It's complex but lets you install the components you want, and even the interface you want. It can do even more than DD-WRT (including Asterisk IP PBXs, Mumble voice servers, BitTorrent clients and DSL support), but it's not for the faint of heart. DD-WRT is based on Open-WRT.
- Tomato (**www.polarcloud.com/tomato**) doesn't have hardware support as broad as DD-WRT, Tomato is arguably more accessible. It bakes a BitTorrent client, Open DNS parental controls and sophisticated bandwidth management right into the firmware.
- Gargoyle (**www.gargoyle-router.com**) is simpler than most open firmwares, and it boasts the ability to set actual bandwidth caps by user or device.

WHAT'S THE NEXT MUST-HAVE ON YOUR GADGET WISHLIST?

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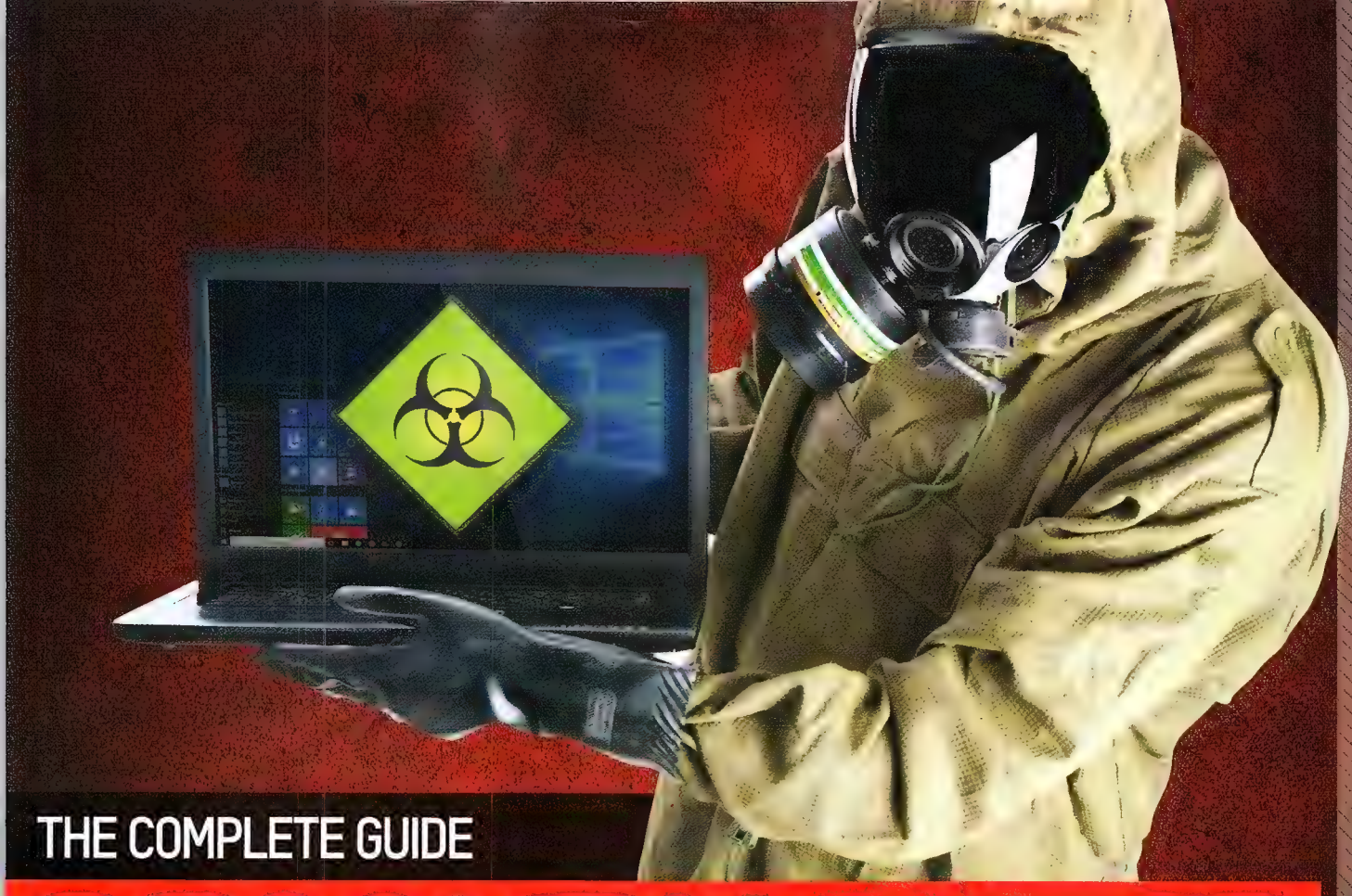


THE COMPLETE GUIDE

DECONTAMINATE YOUR PC!

PC REELING FROM THE EFFECTS OF MALWARE? HARD DRIVE OVERLOADED WITH UNWANTED PROGRAMS AND DUPLICATE FILES? DISCOVER HOW TO CLEAN OUT ALL THE PC JUNK.

Despite your best efforts – and the occasional reinstall – Windows continues to accumulate junk files. Whether it's simply cluttering up your hard drive with unused and unwanted programs or something more sinister, such as a malware infection or full-blown ransomware attack, the fact remains that your PC's storage drive attracts detritus like a magnet. In this feature, we'll show you how to fight back.

We'll open by making sure your PC is completely free from infection – even if you're diligent about security, it never hurts to make sure you're not harbouring some particularly sneaky piece of malware. Crucially, we'll reveal tips and tools that can help you shift most infections from your computer – including many ransomware variants that have your data or computer held hostage.

We'll then move on to less malicious – but still unwanted – PUPs (potentially unwanted programs) before focusing our attention on other forms of junk, including leftover files and duplicate photos. And having carried out all the rubbish, we'll reveal what security tools you need in place to prevent further infection, along with some tips for reining in program installations going forward – and how to carry out a complete Windows reinstall if you need to.

By the end of this feature, you'll have reclaimed gigabytes of hard drive space and banished unwanted programs. Your PC will be faster, cleaner and – critically – safer to use.

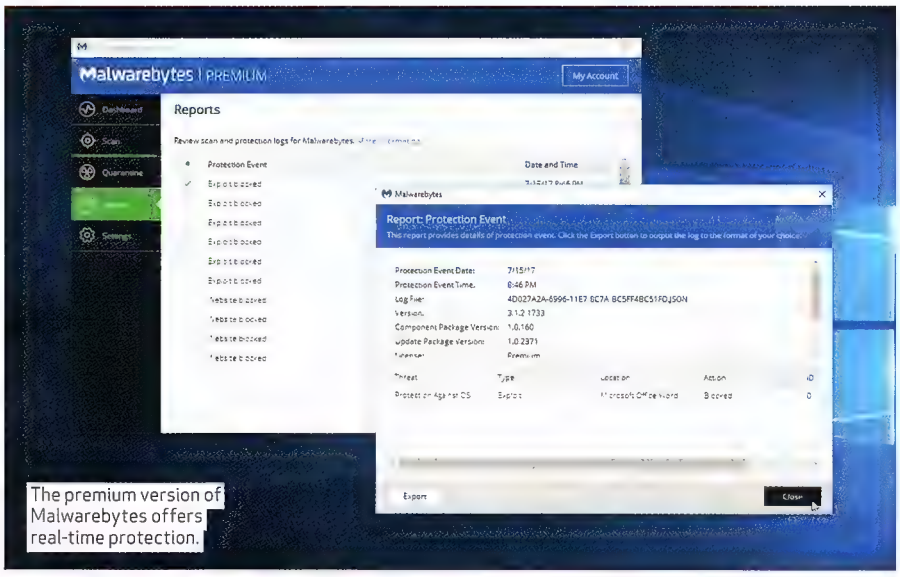
Check for malware

Make sure your PC is free of ransomware and other infections, and if it's not, discover how to deal with them.

Step one of the decluttering process is to make sure your PC is infection-free. Start by opening your antivirus tool to search for malware infections such as worms, Trojans, rootkits and spyware. Make sure its definitions are up to date, then allow it to perform a full scan. If infections are found, follow the instructions to either quarantine or attempt removal of the malware – you'll almost certainly be prompted to reboot when you're done, in which case, run a full scan again to verify the infection has gone.

Some infections can be stubborn – if after two or three attempts the infection is still present, reboot into Safe mode. Those running Windows 7 should tap F8 when the computer starts to boot; Windows 8.1 and 10 users need to navigate to 'Start > Settings > Update & security > Recovery', then click 'Restart now'. Under 'Advanced start-up', navigate to 'Troubleshoot > Advanced Options > Start-up Settings'. Click Restart and press 5 to select 'Enable Safe Mode with Networking'.

Once in Safe mode, try updating and running the scan again – most, but not all, malware should be sufficiently crippled in Safe mode to allow its complete removal. If the infection is still there, or you're locked out of Safe mode, the step-by-step guide on the opposite page reveals further tools and tips to try.



The premium version of Malwarebytes offers real-time protection.

> "Most, if not all, malware should be sufficiently crippled in Safe mode to allow complete removal."

WIDEN YOUR SCAN

Even if your main antivirus tool comes up clean, don't assume you're out of the woods. Let's perform some additional scans with other tools to make sure. Malwarebytes Anti-Malware (**www.malwarebytes.com**) is our favourite security app for delivering a second opinion – it searches for a wider range of threats than most anti-malware tools, including potentially unwanted programs that may come with spyware or other privacy issues. You'll need to download and install the free version, but once in place you can update it and run a full scan as with your main security tool – it'll even run in Safe mode.

If you want to go further, use the Emsisoft Emergency Kit – as featured in the step-by-step guide – to perform scans using two separate antivirus engines. Other portable tools worth adding to your security toolkit include ClamWin Portable (install this through **portableapps.com**) and VIPRE Rescue Disk (see the step-by-step guide). Both may find and remove more stubborn infections. If you're convinced you've been attacked by a rootkit, then open Malwarebytes and go to 'Settings > Protection' to flick the 'Scan for rootkits' option to On.

Tweaking.com's Windows Repair tool can quickly undo damage left behind by malware.

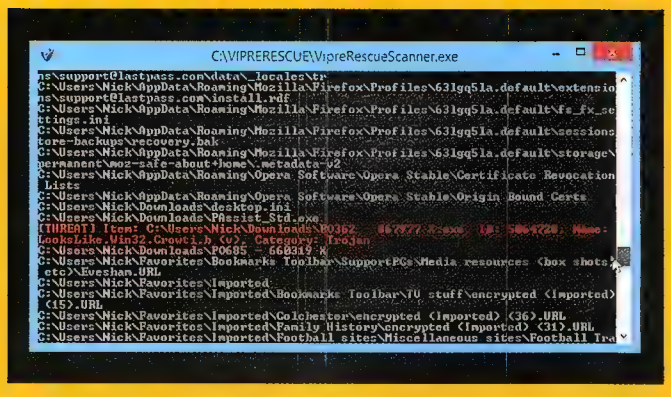
RECOVER FROM RANSOMWARE

If you encounter ransomware, don't panic. This is doubly true if you have a backup somewhere – whatever else happens, you can wipe your PC's storage drive and reinstall Windows and live with a small loss of data.

In cases where you're locked out from your data, make a note of any demands (Bitcoin wallet address, file list of encrypted data and so on), which may give you access to your data later if the criminals are caught and the private keys used to scramble your files are released. Next, perform scans with all the anti-malware tools at your disposal to dispatch the underlying infection. Only when it's removed should you visit **noransom.kaspersky.com** to see if your infection is covered by one of the six free ransomware decryption tools on offer. Other vendors worth checking out include AVG (**www.avg.com/en-au/ransomware-decryption-tools**). If you find yourself locked out of your PC by ransomware, try Trend Micro's free Ransomware Screen Unlocker Tool (**bit.ly/trendransomware**), which can be run in Safe mode or prepared on another PC if you can't even get that far.

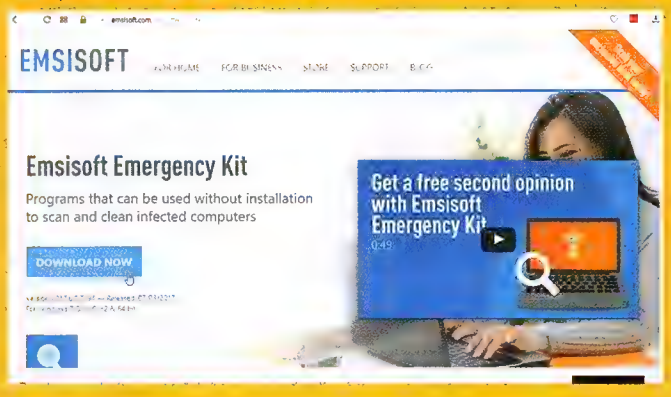
After you've cleaned your PC, you may find certain functions haven't been restored. Broken network connections can often be fixed with the help of NetAdapter Repair All In One (**sourceforge.net/projects/netadapter**). If Safe mode still won't work, or you're locked out of key parts of your system, then run the Windows Repair Tool (**www.tweaking.com**). Not only does it give your PC the once-over, it'll reset Registry and file permissions, and perform other much-needed repairs.

Recover from stubborn infections



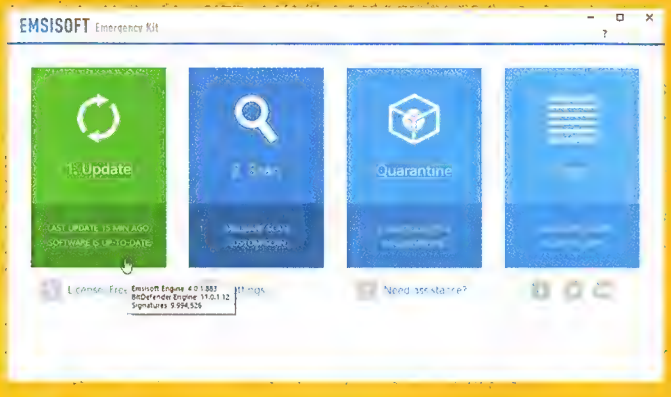
1 ZAP NASTY MALWARE

If you can restart your PC in Safe mode — see the main body text opposite to find out how — with networking, then go to **www.vipre.com/support/rescue** to download a free tool that specialises in removing stubborn malware. If you can't get online in Safe mode, download it on a clean PC and transfer it across.



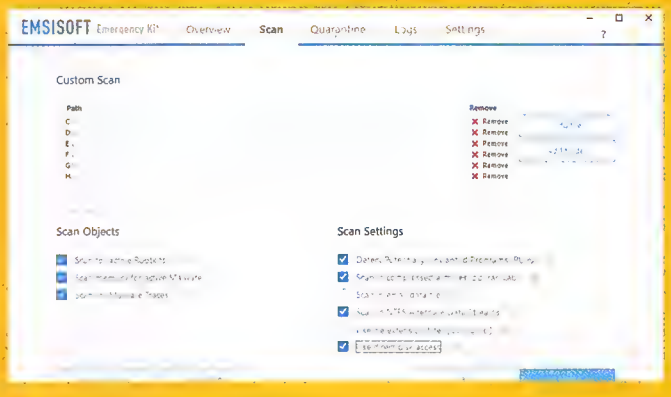
2 SCAN WITH TWO ENGINES

If you can boot your PC, but can't get into Safe mode and have limited access to your system, download and install the portable Emsisoft Emergency Kit (**www.emsisoft.com/en/software/eek**) on to a USB flash drive on a clean PC. Be warned, it's 311MB, so make sure the drive has enough free space.



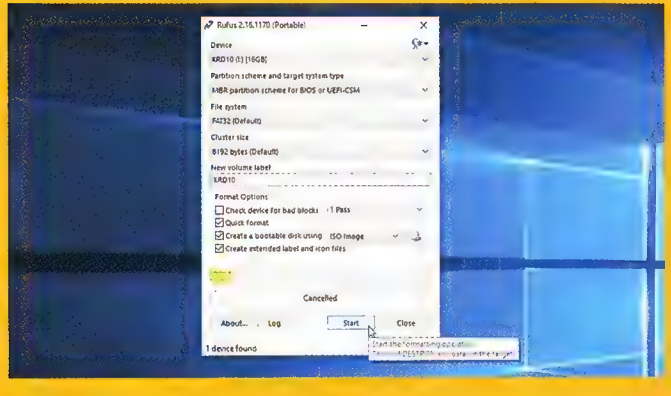
3 PREPARE THE SCANNER

Launch the tool on your clean PC, and select the Emergency Kit Scanner. Click Yes when prompted to download the latest updates. Once that's done, close the tool and then plug the drive into your infected PC. Launch the scanner tool again — you should see that it's now up to date.



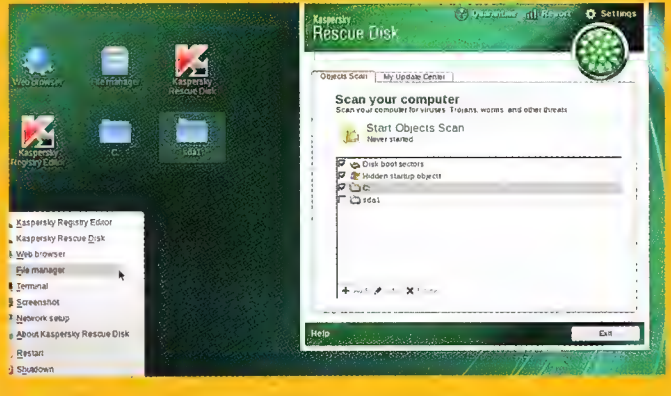
4 SCAN AND REMOVE

For basic malware infections, click Malware Scan. If you suspect that your PC has been infected by a rootkit, click Custom Scan and tick 'Use direct disk access' before clicking Next. You can also perform a custom scan to root out potentially unwanted programs (PUPs) if you so wish.



5 CREATE BOOTABLE DISC

If all else fails, create a Kaspersky Rescue Disk — download the ISO from **support.kaspersky.com/viruses/rescuedisk** to a clean PC. Either right-click the ISO and choose 'Burn image' or use a tool, such as Rufus (**rufus.akeo.ie**), to create bootable media stored on a USB flash drive.



6 BOOT AND SCAN

Restart your PC from your boot media — if your PC has a UEFI and it doesn't work, you'll need to go into your UEFI settings to make sure that compatibility mode is enabled to support the rescue disk. Once loaded, let Kaspersky Rescue Disk scan and remove any infections, then reboot your machine.

Remove unwanted junkware

The worst offenders have been sent packing from your Windows PC, now it's time to move on to the other undesirables.

Next, we're moving on to programs, add-ons and files that inhabit a 'grey area' – these are potentially unwanted (hence the term PUPs) and fall into a number of categories. Most PUPs are installed alongside seemingly legitimate software – usually for financial reasons, an increasing number of supposedly free tools are bundled up inside installers that attempt to do more than simply install the original program.

These additional actions may be to attempt the installation of further programs. Others offer you browser toolbars while attempting to change your browser search settings or homepage. The offerings are usually legitimate, but the tactics used to get them on to your PC are not. Items are usually pre-selected, and it's not always clear which options you need to select in order to remove those unwanted items thanks to confusingly worded buttons or dialog boxes.

Some security software can block these attempted installations at their source – see the 'Block PUPs' box on page 53 – but if you've not been particularly careful, you may find your browser sagging under the weight of multiple toolbars and competing search engines.

Java is well-known for installing unwanted bundleware. Choose the right settings.

Retoring your PC to its factory settings can also cause unwanted bloatware to be reinstalled.

REMOVE THE PUPS

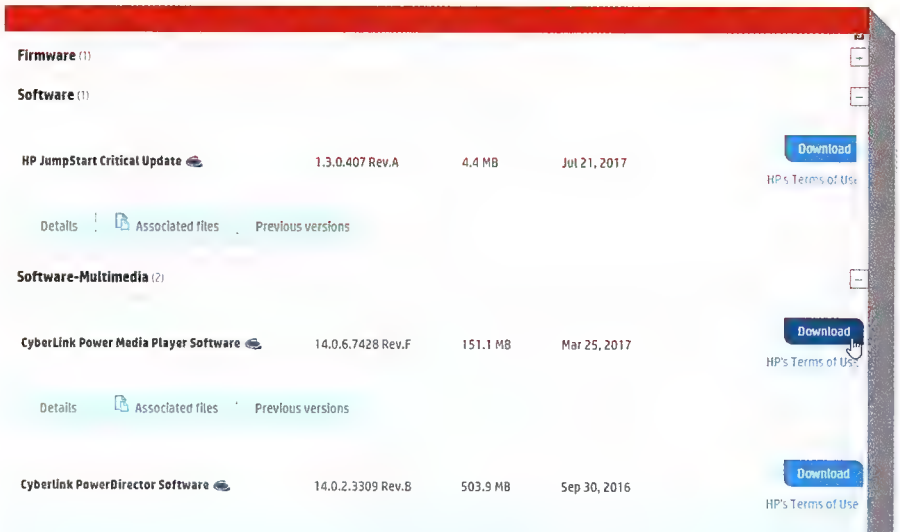
If you've already taken our advice and performed a scan using Malwarebytes Anti-Malware, then you've probably already removed the most insidious PUPs – unlike your regular security software, Malwarebytes is hot on detecting programs with dubious recommendations. They'll be clearly marked as PUPs in the scan results. Malwarebytes also offers AdwCleaner, which targets browser-related items – toolbars, add-ons, search hijackers, browser redirects and other unsavoury items – in addition to adware and PUPs. It's worth running if you're struggling to reclaim control of your web browser. Get it from **www.malwarebytes.com/adwcleaner** – unlike Malwarebytes itself, you don't need to install AdwCleaner before running it.

IT KEEPS ON COMING

Rogue program installers aren't the only source of junk. If you bought a PC from one of the major manufacturers, chances are it came with a host of pre-loaded software. Some of it might be useful, but most it – including all those trials – is just junk. You could wade through it all manually following the tips on the following two pages, but why not employ the services of a third-party tool to root it all out for you?

PC Decrapifier (**www.pcdecrapifier.com**) is one such free tool, which we feature in the step-by-step guide opposite. It can uninstall multiple programs at once with minimal intervention, and we like the fact it filters its results into three categories: Recommended, Questionable and Everything Else. You get to see how many other users have removed the software and then choose exactly what you want to remove – remember, you're under no obligation to remove anything, even recommended entries.

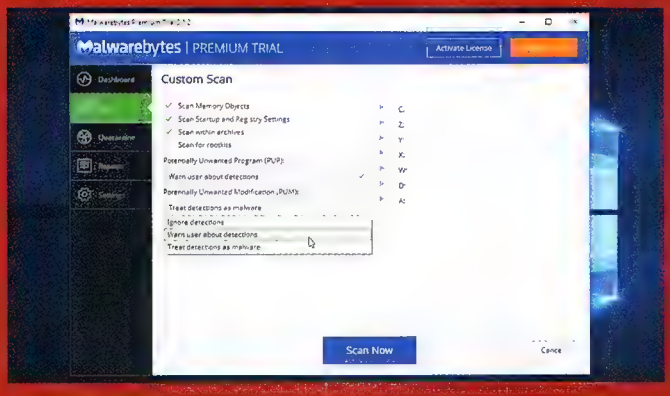
With these techniques, you should be able to remove all malicious and potentially unwanted software from your PC with the help of the step-by-step guide opposite. But what if you want to go even further? Turn the page to discover more ways to declutter your PC and reclaim both lost storage space and system resources.

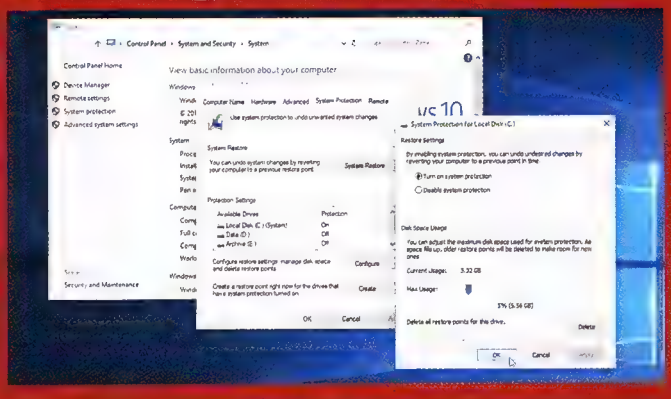


Banish bloatware for good

If your PC came with Windows pre-loaded, then all the bloatware that came with it is waiting to make a return the moment you restore Windows following your manufacturer's instructions. If you prepare properly by creating a rescue disk with Macrium Reflect Free (**www.macrium.com/reflectfree**), you can craft your own streamlined Windows 10 installation, free from all those unnecessary programs and trials. If there are programs you will miss — say, a DVD Player — then visit the downloads section of your manufacturer's website where you should be able to download those individual applications that you do use (along with all the hardware drivers you'll need).

Remove undesirables from your PC



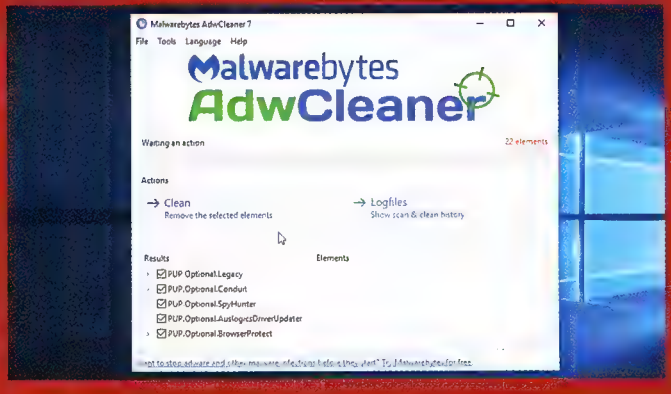


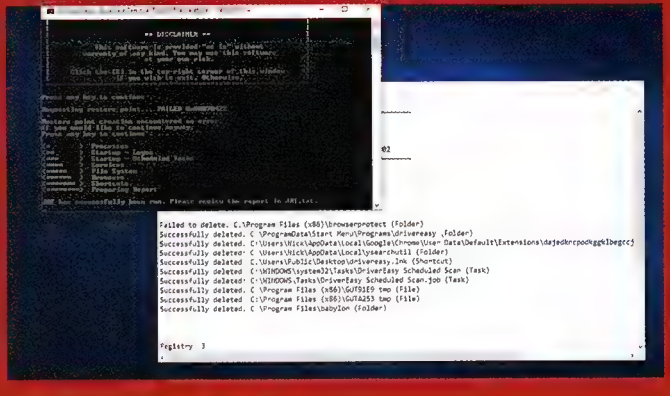
1 CHECK FOR PUPS

If you've not already done so, run Malwarebytes Anti-Malware. The free version is all you need: select Scan and choose Threat Scan if you want all PUPs treated as malware, or select Custom Scan to be alerted, enabling you to choose whether or not to remove the detected programs.

2 ENABLE SYSTEM RESTORE

Some of the following tools will offer to take a Restore point in case you mistakenly remove the wrong program. Press Win-Pause/Break, and click System Protection. If your system drive isn't protected, select it and choose Configure to do so. Set it to around 5GB or 5% of available space.



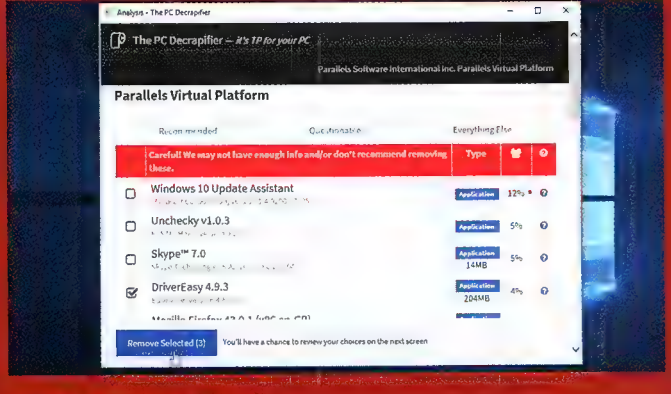


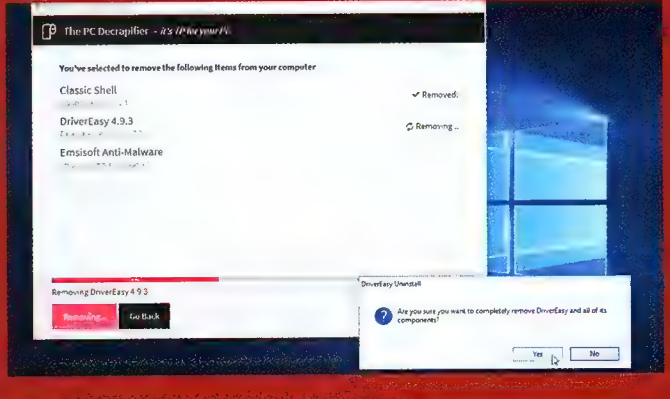
3 GET RID OF ADWARE

Malwarebytes' AdwCleaner tool targets other areas of your PC. It'll detect software and browser add-ons you've freely installed, but which come with a bad reputation. It can also remove them for you — perfect in cases where the software has made it as tricky as possible to uninstall.

4 REMOVE MORE JUNK

Malwarebytes also produces the Junkware Removal Tool — if you're still suspicious about what's on your PC, download and run this from **www.malwarebytes.com/junkwareremovaltool** for an additional scan. Note that it'll remove everything it finds — you can't pick and choose.





5 TARGET BLOATWARE

Next, open the PC Decrapifier utility and click Analyze to let it scan your system. Work your way through each of the three tabs ticking any programs that you no longer want — note that all of your installed programs are listed under Everything Else, so treat these with additional caution.

6 REMOVE UNWANTED SOFTWARE

Click 'Complete Removal' when you've selected the programs that you want to remove. Review the programs list — click Go Back to make changes, or Begin Removal Now to let PC Decrapifier remove each program in turn — follow any on-screen prompts to uninstall specific tools.

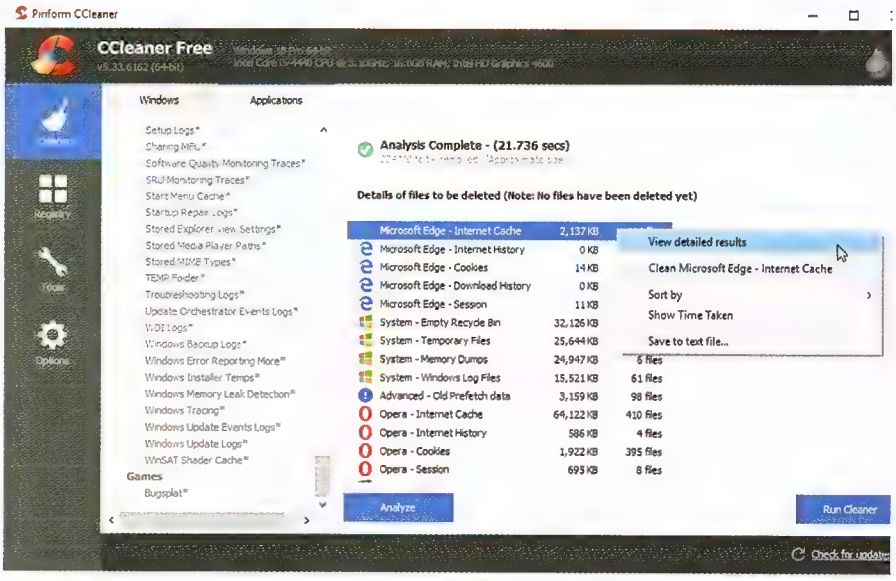
Remove more junk

You have freed your machine from the tyranny of malware and adware, now it's time to perform an even deeper clean.

Your computer should now be free from infections and unwanted software, but there's plenty more junk clogging up your PC, so in this section we're going to perform a deep clean.

Let's start by targeting leftover files by installing the latest version of CCleaner (**www.piriform.com**). Launch the program and then carefully go through the Cleaner section (split into two tabs: Windows and Applications) to see what's pre-selected for cleaning. We'd recommend de-selecting everything under Windows Explorer to preserve previously opened file lists. Also, be careful on the Applications tab and think long and hard about deleting app settings you use frequently – if space is desperately low, then target your browser's cache but leave other settings untouched.

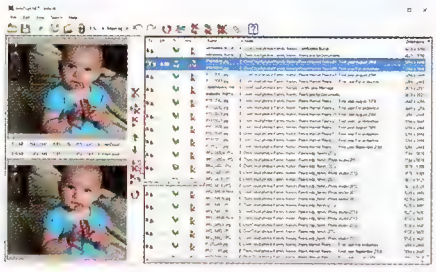
Once you're happy with your choices, click Analyze. CCleaner will scan your selected items and then provide you with a summary of how much space it's going to free up. Before committing to anything, though, right-click each entry and choose 'View detailed results' to examine exactly which files are going to be deleted. You can exclude individual items by right-clicking them, but if you want to exclude an entire category, you'll need to untick it in the left-hand pane and click Analyze. Check your choices again and then click Run Cleaner, read the warning – the Recycle Bin is bypassed, so there's no going back – and click Yes to free your drive space.



Dump gigabytes of unwanted data from your drive using CCleaner — but use it with care.

MORE CLEANING OPTIONS

CCleaner can help with other aspects of your cleaning too. Time to clear out some of those resource-hogging browser add-ons you don't use. You can do this from within your browser, but CCleaner offers a convenient location for managing all the add-ons in all your installed browsers. Select 'Tools >



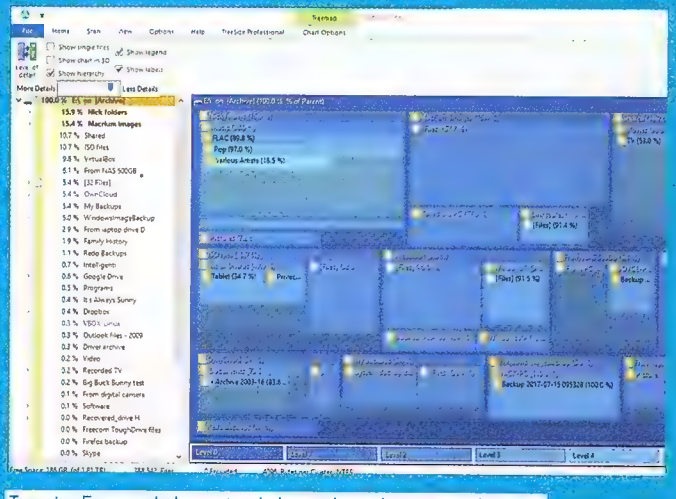
AntiDupl can help you remove all those duplicate and similar photos you've been sitting on.

Visualise drive space

Locating where those space-hogging files are can be an art in itself, particularly if you've exhausted all the usual suspects, such as your Pictures, Documents and other user folders. You could, of course, laboriously go hunting inside every single folder manually, right-clicking and choosing Properties, then waiting while its contents are totted up and a folder size produced, but a better option is to employ the services of a third-party tool designed to provide a visual overview of your drive's state.

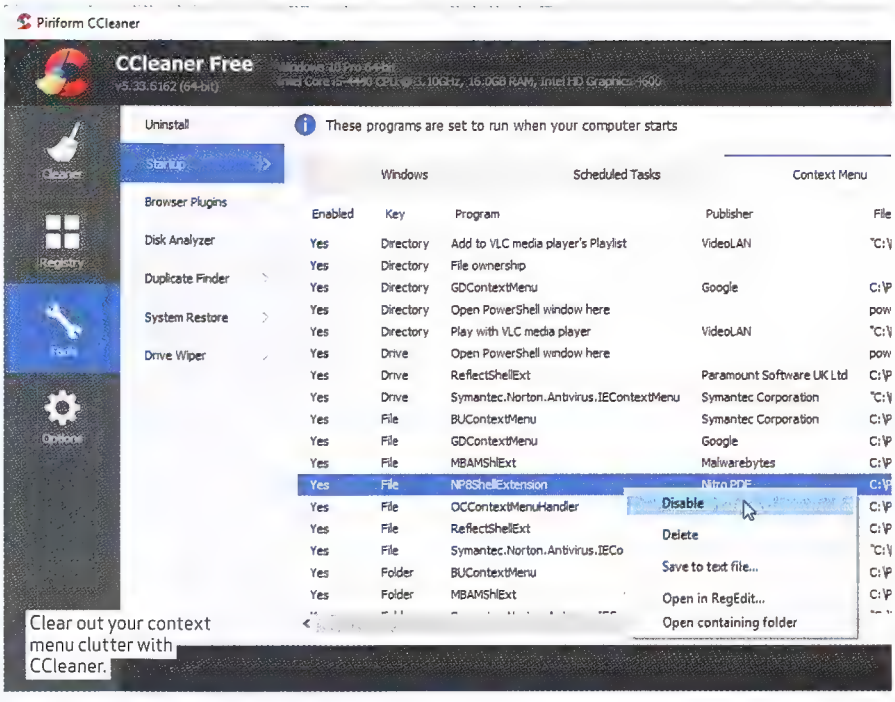
CCleaner offers a Disk Analyzer under Tools that enables you to search by one or more file categories and storage drives, providing a useful graphical summary and a list of files in order of file size. Right-click a file to reveal various options, including that all-important delete option.

For a broader overview of what's taking up space on your PC, try Treesize Free (**www.jam-software.com/treesize_free**), which also provides you with a tree map alongside a details view that offers a block-like visualisation of the selected drive. Simply double-click on a folder to drill down, and Treesize Free will display the information you need — such as the size of files.



Treesize Free can help you track down where those space-hogging files and folders reside on your computer's storage drives.

Browser Plugins' and you can manage your extensions, helpers and toolbars from one spot, with each supported browser represented under its own tab. Disable first, then delete once you've verified you don't need the extension. Next, select Startup – not only can you manage the apps that start with your PC, but you can also manage scheduled tasks, enabling you to see what programs are doing in the background. Switch to the Context Menu tab and you'll also be able to streamline the menus that pop up when you right-click various items, such as folders or files, in File Explorer. Again, start by disabling items before deleting them, just in case. If you're struggling to identify them, check the Publisher and File fields as well as the Program one.



REMOVE DUPLICATES

One of the biggest ways in which space is wasted on your PC's main storage drive is through the proliferation of duplicate files. CCleaner possesses a duplicate finder, but it's pretty basic. If you're looking to weed out duplicates of all types, the step-by-step guide below reveals how to use Duplicate Cleaner Free (**www.digitalvolcano.co.uk/duplicatecleaner.html**). It can be a slow and frustrating process, but don't panic if it appears to be non-responsive. You can close the program at any time and when you next restart it, Duplicate Cleaner will pick up where it left off.

One obvious source of duplicate files are photos. In this digital age, we're encouraged to take multiple snaps of the same shot to try and get the perfect one, but this results in a host of visually similar – if not quite identical – photos cluttering up your PC. This is where AntiDupl (**sourceforge.net/projects/antidupl**) comes in, since it's capable of identifying similar as well as exact copies of your photos.

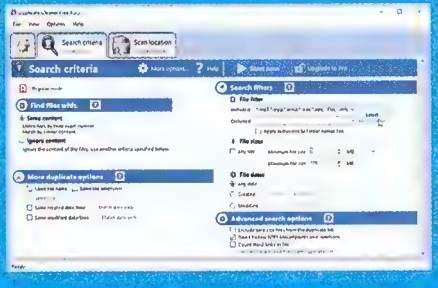
Once installed, launch the app and start by choosing 'Search › Options'. Tick 'Search rotated and mirror image dupls'. Click 'OK' and then select 'Search › Paths' to choose which folders and/or drives to search. Make sure the first folder you choose is your 'master' folder – the photos inside here will be considered the original, with duplicates from other folders being removed.

Then it's a case of clicking the Play button and waiting while the search is performed – if it's taking a long time, click Background Mode to minimise the app to the Taskbar notification area.

Analysing the results is a time-consuming process – each duplicate or visually similar match is listed as a pair. Each pair is accompanied by a Hint, which indicates which copy will be deleted by default. You can review each match using the controls and change the default behaviour using the buttons next to each photo – roll your mouse over an option for an explanation of what does what. Click one and the action will be performed, with your unwanted file sent to the Recycle Bin (so you'll need to empty this when you're done).

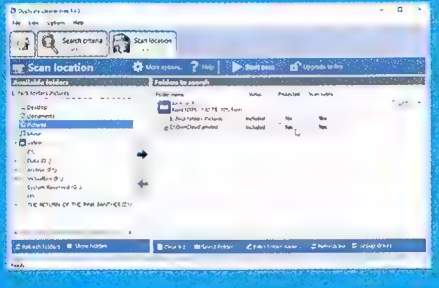
Click Exit at any time for a break – when you relaunch the program later, you can pick up where you left off.

Remove duplicate files



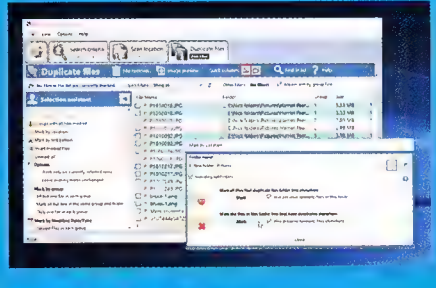
1 SET SEARCH CRITERIA

Open Duplicate Cleaner Free and click New Search. By default, the program will match files by content only, but you can make it match by other criteria, such as name, the date it was created or last modified and so on. Click 'Select' to choose a type of file to search for – documents or pictures, for example.



2 SCAN LOCATIONS

You can also limit your search to specific file sizes and dates. Once you're happy with your selections, switch to the Scan Location tab so that you can select the drives or folders that you want to include in your scan. Click 'Protected' next to a folder to ensure its files aren't removed by Duplicate Cleaner Free.



3 SCAN AND REMOVE

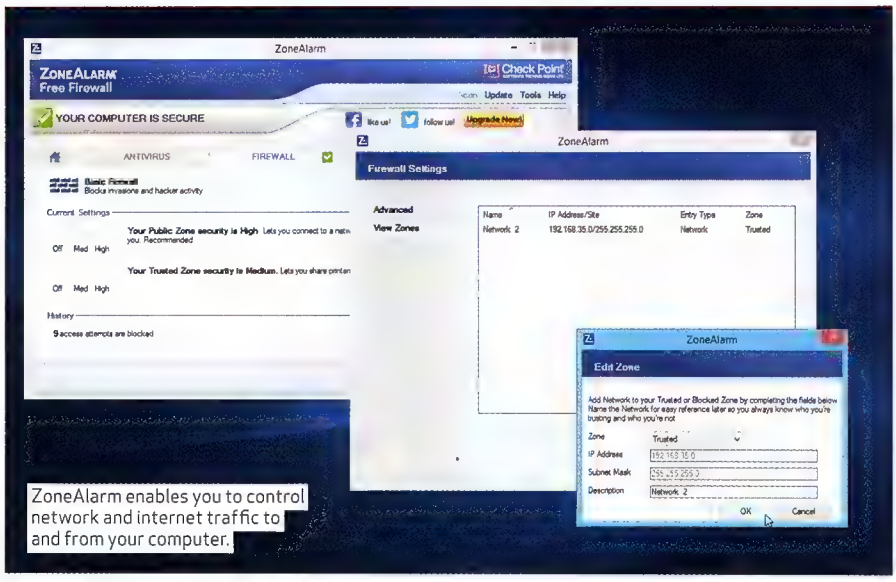
Click 'Start scan' — Duplicate Cleaner Free will begin searching and a progress box will keep you informed of what's going on. Click 'Close' when done to choose which files to mark for deletion using the 'Selection assistant' tool to guide you. Click 'File removal...' to remove the duplicates once and for all.

Stay infection- and clutter-free

You've disinfected your PC and cleared off a load of junk — now it's time to strengthen your security and keep the clutter from your machine.

You've reclaimed control of your PC and banished malware along with unwanted software and other useless files. How can you protect yourself – and keep your PC clutter-free – going forward?

Let's start with security. These days, threats to your computer come in many shapes and forms. In spite of the best efforts of security vendors, there's no one-size-fits-all-approach to protecting your PC, so examine what threats are out there and – crucially – how to protect yourself against them.



ZoneAlarm enables you to control network and internet traffic to and from your computer.

THE THREATS

Malware is a constantly evolving beast, from its humble beginnings as a virus – a piece of code that replicated itself to spread havoc. The virus became a worm – a standalone program that can cause damage as well as spread, which in turn became a Trojan, which appears legit but in fact carries a nasty payload.

The payloads have changed too, from simply downloading more software to deleting files on your storage drive to now locking you out of your PC or your files through encryption in the form of ransomware. Then there's spyware, backdoor infections, rootkits, zero-day exploits... Need we go on?

The key thing is to protect yourself against them. How you protect your PC is up to you, but if you're serious about security, don't rely on Windows Defender and the built-in Windows Firewall. Either splash out on a feature-packed, but resource-friendly suite, such as Norton, or mix and match a selection of free anti-malware tools.

Start with Bitdefender Antivirus Free (**www.bitdefender.co.uk/solutions/free.html**) and ZoneAlarm Free Firewall (**www.zonealarm.com/software/free-firewall**). ZoneAlarm lets you block threats from communicating with the outside world – something the Windows Firewall doesn't do by default. It's pernickety about which antivirus apps it'll work with, but Bitdefender is fine.

After installing ZoneAlarm, go into your firewall settings and select View Zones. You should see your home network has been added and placed in the Public zone, which restricts access to shared files and other resources. If you trust your network, click Edit and switch its zone to Trusted.

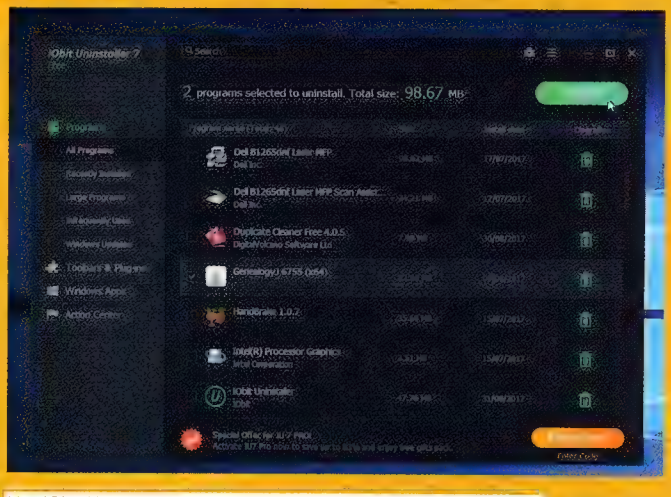
Add Malwarebytes Anti-Malware (**www.malwarebytes.com**) – the free version will detect and remove threats missed by other tools, but if you can

Simplify Windows tweaks

One of the biggest causes of clutter are programs that leave traces of themselves — leftover files and Registry entries — behind when you remove them. Use a tool, such as IOBit Uninstaller (**www.iobit.com/en/advanceduninstaller.php**), to thoroughly scrub programs from your PC — it'll also work with Windows Store apps too, including those that came pre-installed with Windows. The latest version of IOBit Uninstaller also drops the annoying prompts to install Advanced SystemCare too, but remember to skip the prompt at the download screen to add a new tab to your browser.

Think twice before installing any program — and get into the habit of using Macrium Reflect Free (**www.macrium.com/reflectfree.aspx**) to take an exact copy of your hard drive on a regular basis, using differential backups to keep the file size down. You can then roll back your PC to remove clutter as well as recover from major problems.

Finally, try to source portable apps where you can — these are self-contained within their own folder, meaning you simply delete the folder to remove all traces of them when you're done. For more details head to **portableapps.com**



Use IObit Uninstaller to remove unwanted programs from your PC and you'll prevent the build-up of leftover files and other detritus.

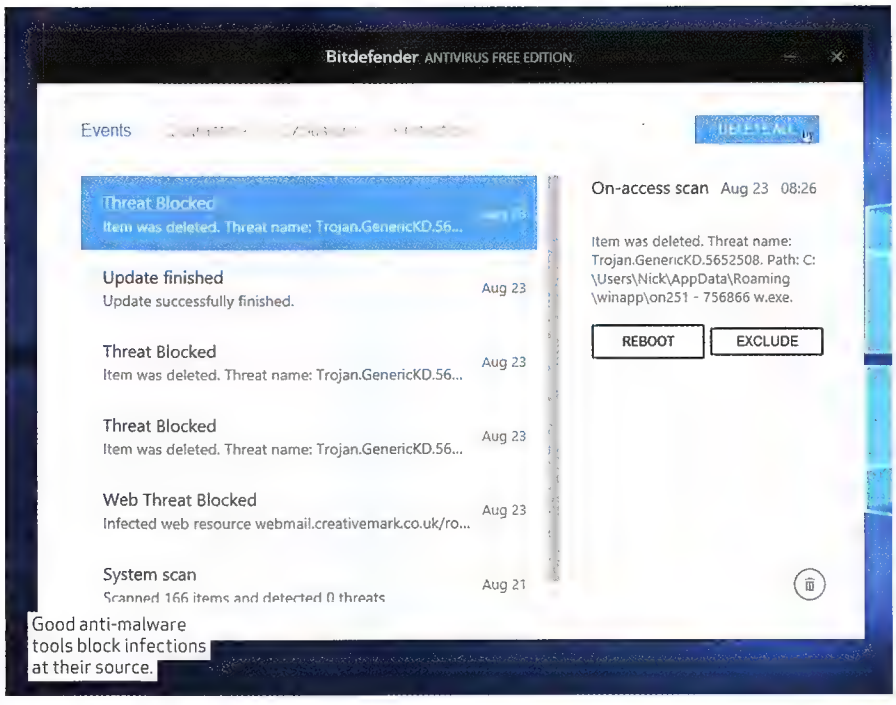
afford the premium version you'll get real-time protection alongside your main tool as well, blocking a wider range of threats, including malicious websites and PUPs at source. We run MBAM Premium alongside Norton to cover all the threats mentioned above.

Ransomware is a nasty type of virus that locks your PC or encrypts your files, demanding a ransom to get the unlock key. Inoculate your PC against many of these threats by installing Bitdefender Anti-Ransomware (**www.bitdefender.com/solutions/anti-ransomware-tool.html**) if your anti-malware software doesn't explicitly offer protection.

Many of these threats originate from dodgy websites – pop-up windows or misleading links. Most browsers now have built-in site-screening tools for the worst offenders, but arm yourself with some form of site vetting plugin, preferably one that rates websites for security and privacy. Sadly, a tool we used to recommend – Web of Trust – has seen its reputation bashed when it was discovered to be selling personal information about its users. The practice has allegedly been stopped, but consider an alternative, such as Norton Safe Web (**safeweb.norton.com**), if you want to vet both websites and search engine results.

Also add Unchecky (**www.unchecky.com**), a free tool that helps protect against inadvertently installing PUPs, and Bitdefender Traffic Light (**www.bitdefender.co.uk/toolbox/freeapps/desktop**). Traffic Light offers some protection against malicious websites.

Finally, strengthen protection against phishing websites and filter internet content for your children by applying security at a network level using the OpenDNS Home service (**www.opendns.com**), which has the added benefit of delivering faster website loading as well.



Good anti-malware tools block infections at their source.

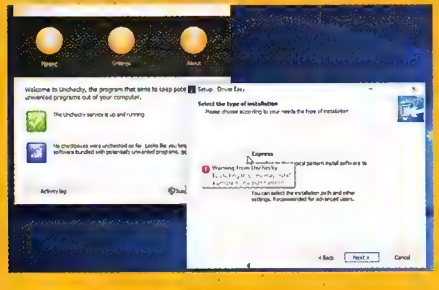
BEHAVIOURAL THREATS

Most threats make their way on to your PC through trickery and deceit. It began with phishing – fake emails that tried to trick people into clicking a link to visit a facsimile of a genuine website in order to capture their login details. Potentially unwanted programs (PUPs) are bundled with genuine programs options to add these generally pop up during the installation process and they're usually ticked by default.

Scareware is a kind of program that exaggerates or makes false claims – typically about security ("Your PC is infected!", "10,000 Registry entries are slowing your computer down!") – to con people into paying for the full version. It can also be delivered by malware.

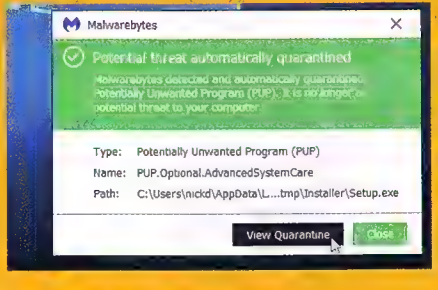
Long story short – be wary about clicking links on websites and in emails. Add a mail-screening tool, such as Mailwasher (**www.mailwasher.net**) or PopTrayU (**poptrayu.sourceforge.net**) to vet your mail before opening it in your email program, deleting suspicious emails. And perhaps dig out your copy of issue 446 for more tips and tricks on securing your PC and network (check out page 46).

Block PUPs



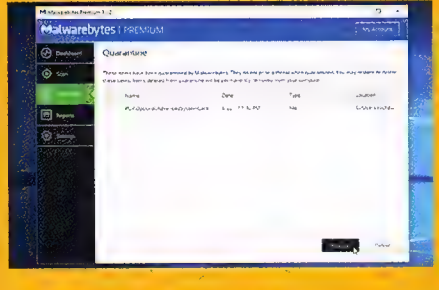
1 INSTALL UNCHECKY

Unchecky (**www.unchecky.com**) works silently in the background – if it recognises a dodgy program installer, it'll quietly make sure any PUP options are unticked or deselected by default. If you subsequently roll your mouse over any dangerous options, a pop-up Warning window will appear.



2 BUY MALWAREBYTES

The paid-for Premium version of Malwarebytes also has built-in blocking tools. These will automatically quarantine programs that are deemed as potentially unwanted when they're detected. If another program is trying to install a PUP, it will be allowed to finish installing if Malwarebytes considers it clean.



3 FIX FALSE POSITIVES

If you're convinced an application is safe – IObit's Advanced SystemCare, for example – then either ignore Unchecky's warnings, or in the case of Malwarebytes, head to the Quarantine section using the menu option on the left and select the allegedly offending item, then click Restore to bring it back.

A full, destructive reinstall

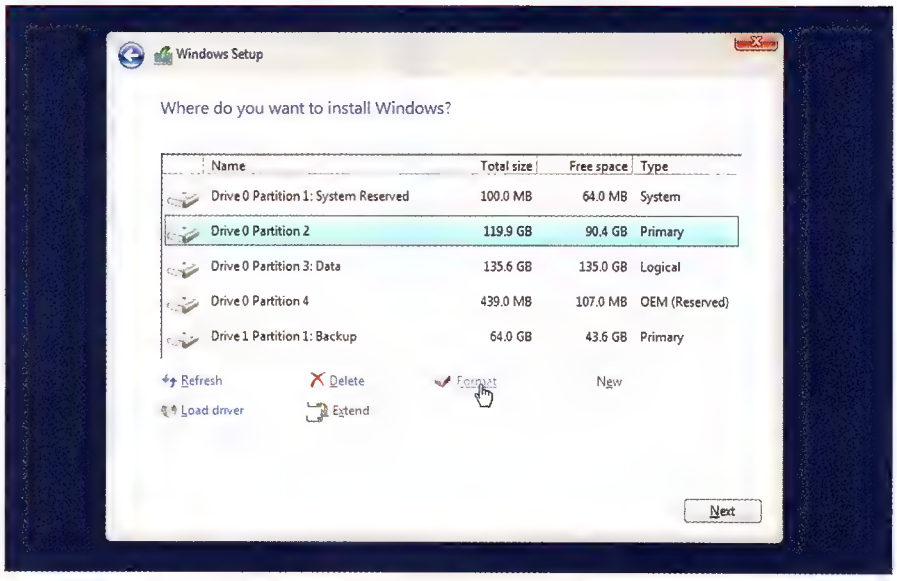
If you're looking to wipe the slate clean, or need to recover from major issues, then the nuclear option is always the best one.

Reinstalling Windows from scratch – namely, wiping your system drive completely clean to install a brand, spanking new (and fresh) version of Windows on to it – is the ultimate choice for anyone looking to revive a slow-running PC or resolve a major, non-hardware issue, such as those caused by malware or a clogged up computer, In this final section, we'll step you through the entire process.

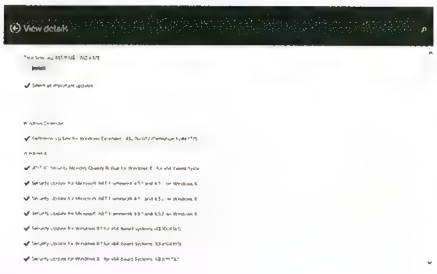
Ideally, you should have a recent and full backup of your PC, created using either File History or the Windows Backup and Restore tool before you begin, that way you'll lose the minimum of content. A full reinstall really is destructive – nothing left on your C drive will exist once you've finished. You should ensure you have the latest installation media for your target version of Windows – head to **www.microsoft.com/software-download/windows10** and click 'Download tool now'. Once downloaded, open MediaCreationTool.exe. When prompted, select 'Create installation media' and follow the prompts. This will ensure a cleaner, more up-to-date installation from the off, thus saving you time bringing it fully up to date once the installation has completed.

It's also worth sourcing networking and graphics drivers now rather than relying on Windows to provide them for you – in most cases, they should be built in, but not always. Consult your PC or motherboard manufacturer's website for these, or visit your Wi-Fi adaptor or graphics card manufacturer's site – download them to your backup drive.

Other things to consider: uninstall any products that require activation now – this should deactivate the licences and allow you to use them with your new install without any issues. Also, be sure to have product keys and program installers to hand.



Windows 10 users can launch a repair install directly from the Media Creation Tool.



Windows 7 and 8.1 users will find a large number of updates waiting to be installed after reinstalling.

Restore programs, settings and data

Once Windows is reinstalled, open Windows Update to bring Windows fully up to date – don't be surprised if there are hundreds of updates. Once it's fully up to date, consider reinstalling Macrium Reflect Free (**www.macrium.com/reflectfree**) and taking your first drive image – a vanilla backup you can restore in future instead of reinstalling Windows itself.

If you want to bring your installed apps along with you after a reinstall, consider using CloneApp (**www.mirinsoft.com**), which can backup app installs to a secondary data drive or external disk. After you've reinstalled Windows, install CloneApp again and click the Restore button, then every program setting you backed up will be restored. If there are any backup settings you don't want to restore, select Options to locate the backup folder, then open it and move any program folders you want to ignore out of the folder temporarily before clicking Restore. Now take your second Macrium Reflect Free backup. Finally, open File History or the Windows Backup and Restore tool and take steps to restore any data you backed up, then make sure the tool is configured to carry on backing up going forward.

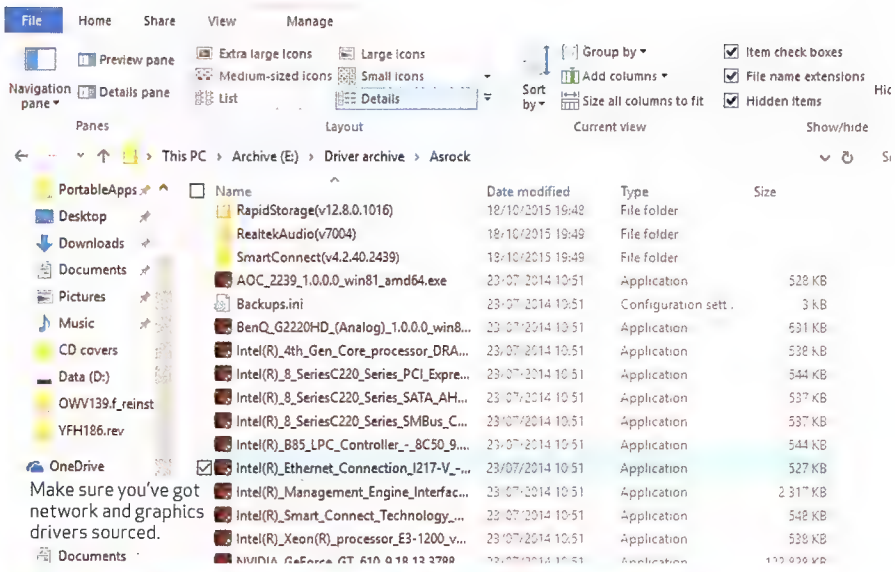
Open File History, link it to your previous backup and then you can restore all your data back to its original location with one click.

STARTING THE REINSTALL PROCESS

A full destructive reinstall should always be started by booting from your installation media, be it a DVD or USB flash drive. The actual reinstall process doesn't differ much across Windows 7, 8.1 or 10. You'll be asked to verify your language, location and keyboard are set correctly, then it's a case of clicking Install Now. If prompted, enter your product key or click Skip if you're running Windows 10 on a PC you upgraded during the free period. When asked what type of installation you wish to perform, choose Custom.

Next comes the potentially trickiest part of the process. A list of drives and partitions will appear – you need to select the one Windows is currently installed on. By default, it should be detected and selected, but verify it's correct before clicking Format (click the advanced Drive Options button if it's not visible). Click OK, then once formatted, verify the drive is still selected and click Next.

That's the technical stuff pretty much done. You'll see a checklist of tasks to be performed – just sit back and wait. One thing to note: when Windows reboots, you may see the 'press any key' prompt again to boot from CD or DVD. Don't press anything if that happens, just let the installer continue.



Make sure you've got network and graphics drivers sourced.

> "Ideally, you should have a recent and full backup of your PC – that way, you'll lose the minimum of content."

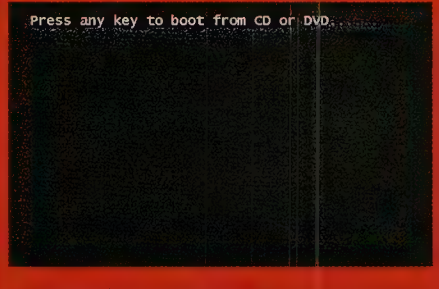
SET UP POST-INSTALL

The post-setup prompt begins with Windows 7 users being prompted for their product key, then it's a case of setting up a user account and you're off and running. Windows 8.1 users will get an Express Settings prompt – be sure to click the option to customise these and go through them carefully. Post-Creators Update, Windows 10 no longer gives you an Express Settings option. For now, confirm your location and keyboard, set up your network if required and choose 'personal use' when prompted. You can either sign in with your Microsoft account or click 'Offline account › Maybe later' if you plan to stick with the old-style Windows 7 local user account.

If you opt for the Microsoft account option now is a good time to set up a PIN to speed up future logins (note: the PIN is tied, specifically, to this PC, and you can always bypass it using your regular account password should you forget it at any point). You'll then be asked to set up Cortana – this is where Windows 10's notorious privacy settings come into play, so review all of the options carefully, flicking the slider to Off for any you don't need or use.

That's the end of the setup process – Windows will now configure itself based on each of your choices and you'll see a series of messages appear on-screen. Eventually, when all is ready, you'll find yourself back at the familiar Windows desktop screen.

Start the install process

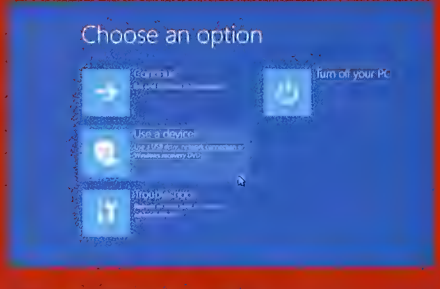


1 REBOOT FOR MEDIA

If you're running Windows 7, or have Fast Boot disabled, insert your boot media and start your PC. Look for a 'Press any key to boot from CD or DVD' option – even if you have booted from a USB flash drive. Press any key on your keyboard and you should find that the Windows install process starts.

2 TWEAK BOOT OPTIONS

If you boot back into Windows, restart your PC again, but this time press a key, such as F11, when prompted to open a boot menu. Once you have done so, select your boot media – choosing UEFI if that option appears – to boot; otherwise, enter setup so that you can change the boot device order.



3 WINDOWS 8.1/10

If Fast Boot is enabled on your computer, open Settings in Windows and then navigate to 'Update & recovery > Recovery', then click 'Restart now' under 'Advanced start-up'. When the boot options appear, choose 'Use a device' to select the USB flash drive or DVD you created from the list that appears.

TODAY'S BEST UPGRADES

Bring your system bang up to date with some choice PC hardware picks from the *APC* team

Upgrading is fundamental to the PC. It's one of the cornerstones of our platform of choice, and it's why the PC has survived while other systems have failed. It's also the reason why you can focus on the hardware that matters the most, and spend your money appropriately. You can upgrade in stages – if you want to focus on a performance CPU first, with a mind to upgrading your graphics card or storage later, you can. As long as you know what's happening in the tech world, you're in good shape.

On that note, we've just had an incredible year for processors. AMD has come out swinging with its Ryzen line, with increased core counts and strong raw performance. And Intel has just responded with its eighth-generation CPU line – we've managed to squeeze the first chips to arrive into our recommendations, too. Which means we're now looking at two completely new mainstream platforms that didn't exist a year ago. Plenty of opportunities for upgrades, in other words.

Bear in mind that any new piece of gear should have a legitimate upgrade path as well. Getting the best processor for your motherboard is fine, but it takes the shine off it a bit if you know there's a whole new platform doing the rounds. That's why our recommendations all relate to the latest hardware lines. This shouldn't stop you upgrading older hardware as far as it can go, though, because that can often be a cost-effective route – especially if you're happy to take the risk of buying used hardware (great for older processor deals, and making the move to SLI).

> "Getting the best processor for your motherboard is fine, but it takes the shine off it a bit if you know there's a whole new platform doing the rounds."

In the following pages, we look at the best hardware upgrades you can buy right now, with performance benchmarks where they matter. We cover all the major components, and highlight things to watch out for when upgrading. It's a great time to give your machine a new lease of life, as you're about to find out.

NVIDIA
NVIDIA CORPORATION
Santa Clara, California, USA
CRUCIAL
BALLISTIX
SPORT DDR4
SAMSUNG
960 PRO
M.2 SSD NVMe

PROCESSORS

HIGH-END

$1,399 WWW.AMD.COM

AMD Ryzen Threadripper 1950X

There is an argument for going with Intel's Core i9-7980XE for your high-end upgrade – it's an absolute beast, with its 18 cores and 36 threads. It does cost $2,859, though. For the vast majority of us, such a move makes no sense. If you want high-end performance that will leave your bank balance vaguely intact, the Threadripper is the way to go. And at $1,399, the 16-core 1950X is the best that AMD has on offer. Yup – half the price for two fewer cores (four threads).

The AMD Ryzen Threadripper 1950X is an incredible slice of silicon, effectively squeezing a pair of Ryzen 1800Xs into one package. There are big wins in addition to the phenomenal core count, too, including 64 PCIe lanes, support for quad-channel DDR4 and 40MB of L3 cache. This is a serious chip that will relish high-end, multithreaded applications. It happily turbos up to 4GHz, and stays cool while doing so; 60°C puts Intel's latest to shame.

The resultant chip is physically huge, so AMD has introduced a whole new package and mounting mechanism – it's an interesting system that helps ensure you don't damage your new motherboard or expensive CPU when installing it.

Speaking of which, you will, of course, need a new motherboard to go along with your top-end chip, and we cover our recommendation for X399 on page 62.

MID-RANGE

$289 WWW.INTEL.COM.AU

Intel Core i5-8400

At last, we've seen it come to fruition. Intel has finally thrown off the shackles of those four-core limitations, and added an additional two cores to the vast majority of chips in its arsenal of mainstream processors. It is, in essence, an effective way of combatting AMD's Ryzen eight-core parts, without having to redevelop an entire architecture to do so.

The Core i5-8400 is the absolute sweet spot in the lineup, and for those looking for a mid-range, no-fuss chip that gets the job done, it's the new king of the hill. Although it still lacks the hyper-threading of its Core i7 superior, the inclusion of those two Coffee Lake cores on top of the usual four provides a raft of additional processing prowess, capable of demolishing the older Core i7-7700K. It is, by far, the best value processor you can buy to date, coming in at a faintly ridiculous $290.

That's not to say there aren't any limitations with Coffee Lake, the big one being temperature. Intel is still refusing to invest in any form of decent thermal interface material between the die and the IHS, and because of that, temperatures are toasty, even on this locked Core i5.

Plus, although the socket may be the same, there's no backward compatibility at all, meaning you'll be investing in a new motherboard as well.

BUDGET

$175 **WWW.AMD.COM**

AMD Ryzen 3 1300X

As an upgrade, a budget chip is a tricky concept. We've been recommending the Intel Pentium G4600 for our budget build for the best part of a year, but when it comes to an upgrade, we can't really recommend a last-gen CPU that slots into a last-gen motherboard. So instead of tying ourselves in knots trying to predict which platform you're upgrading from, we've picked a chip that offers strong performance at a great price point.

The Ryzen 3 1300X may not have the headline-grabbing thread count of the top-of-the-range 1800X, but this is still an unlocked quad-core chip for not much cash. Talking of cost, you'll need to buy an AM4 motherboard to use it, and possibly some DDR4 memory to go with it, if your current system is a little long in the tooth.

So that $175 price tag isn't the whole story, but this is still a good value proposition, with a decent upgrade path of its own, which is always worth considering at the budget end of the scale. The retail chip comes with the Wraith cooler as well, which does a fine job of keeping it cool while hitting the 3.7GHz turbo, so no immediate need to grab a separate all-in-one to get the most from this chip.

> "A chip that offers strong performance at a great price point."

PROCESSOR BENCHMARKS

CHIP	CORES/ THREADS	X265	CINEBENCH R15 SINGLE	CINEBENCH R15 MULTI	FRY RENDER	POWER DRAW IDLE	POWER DRAW LOAD	TOTAL WAR: ATTILA	FAR CRY PRIMAL	PRICE
INTEL CORE I9-7980XE	18/36	41.12	184	3,331	64	66	258	41	77	$2,859
AMD RYZEN THREADRIPPER 1950X	16/32	38.29	167	3,012	84	91	271	35	75	$1,399
INTEL CORE I9-7900X	10/20	38.15	180	2,218	94	86	223	41	77	$1,329
AMD RYZEN THREADRIPPER 1920X	12/24	35.39	152	2,308	127	67	243	37	75	$1,099
INTEL CORE I7-7820X	8/16	30.45	194	1,741	122	83	197	40	76	$789
AMD RYZEN 7 1800X	8/16	27.89	159	1,612	161	56	182	39	75	$649
INTEL CORE I7-8700K	6/12	30.65	205	1,553	133	65	198	41	77	$589
AMD RYZEN 7 1700X	8/16	26.81	154	1,542	172	57	143	39	74	$489
INTEL CORE I7-7700K	4/8	20.68	194	970	225	44	110	41	77	$449
AMD RYZEN 7 1700	8/16	24.12	147	1,406	178	47	115	35	73	$419
AMD RYZEN 5 1600X	6/12	22.18	159	1,223	226	45	115	36	74	$329
INTEL CORE I5-7600K	4/4	15.86	179	663	346	44	103	40	77	$319
INTEL CORE I5-8400	6/6	22.24	172	956	231	44	123	41	77	$289
AMD RYZEN 5 1500X	4/8	15.85	154	807	329	42	101	36	75	$245
AMD RYZEN 5 1400	4/8	13.61	131	693	380	55	93	33	71	$219
AMD RYZEN 3 1300X	4/8	12.64	139	550	462	56	95	36	73	$179

GRAPHICS CARDS

HIGH-END

$1,130 | WWW.NVIDIA.COM

MID-RANGE

$669 | AU.MSI.COM

Nvidia GeForce GTX 1080 Ti

Graphics cards are in a bit of an odd state right now. For the last 18 months, Nvidia has been left unchallenged, with AMD only providing any hint of competition in the mid-range. The RX 500 refresh was little more than a badge swap, and Vega a dud – a disappointing high-end solution, overhyped to its own detriment (although it struts its stuff nicely when it comes to cryptocurrency mining, annoyingly).

So how does the land lie if you're looking to invest in a high-end GPU? How do you power a 4K gaming rig in today's market? Well, fortunately, Nvidia hasn't been resting on its laurels, and is still focused on trying to capture as much of that market share as it can. At the start of this year, it dropped the bombshell that is the GeForce GTX 1080 Ti, and hasn't really looked back.

Think of it as a cut-down Titan Xp, a warhorse of a GPU focused solely on gaming, but coming in at a far more attractive price point. The differences are slim, with its 1GB of GDDR5X being one of the few things cut from the titanic juggernaut. The Titan Xp is ever so slightly more powerful – about 15% or so – but it also costs $800 more, making it a superfluous product aimed solely at the affluent, or those who need the Titan's very specific developer skill set, as limited as it is.

MSI GTX 1070 Gaming X 8G

Oh, how mid-range has changed over the last few years. Once upon a time, the card to have for anyone wanting a fairly healthy PC was the GTX 660 Ti. It was cost-effective, powerful for its day, and clocked like a champ. However, as the battle lines widen, and GPU prices extend ever upward, our idea of what a mid-range card actually includes has inevitably increased, too.

It isn't all bad, however, because central processing prowess becomes ever more affordable – offsetting the GPU price with a cheap CPU balances the books, while providing higher frame per second solutions for the same amount of green.

The GTX 1070 is a prime example of this. With performance matching the height of Maxwell's frame-rendering capabilities, it's a card that makes the once-premium 9 series Titan X affordable, cutting the price by 66%.

MSI's Gaming X variant provides an exceptionally fine balance between noise reduction and thermal management. There's no superfluous RGB lighting here, and the only hint of any 'gaming' heritage lies in the small red accents located under the card. Couple that with a powerful stack of 8GB GDDR5X and its bunker-busting Pascal GPU, and the GTX 1070 dominates 1440p with ease, providing average frame rates well into the 60fps range that every enthusiast with a gaming habit covets.

BUDGET

$329 | **WWW.EVGA.COM**

EVGA GTX 1060 3GB SC Gaming

So where is AMD in all of this? The sad reality is that AMD isn't providing any competitive solutions at any of the right price points. Vega's lack of availability and sub-par performance has left the upper echelons empty, while the mid-range and budget solutions suffer from cryptocurrency fever.

Unless you absolutely cannot live without FreeSync, there is no justifiable reason to run with an AMD card, either as an upgrade or in a fresh build.

At the budget end, there's only one choice – the GTX 1060 3GB. We've recommended it all year, and for good reason. It's at the price and performance sweet spot, even up against Nvidia's own GTX 1050 Ti.

Look at the figures – for $90 more, you get a card that's 50% faster than the next step down, gives the GTX 980 a run for its money, and masticates 1080p. Because Nvidia's GTX 1050 Ti is so unattractive, seemingly nothing more than a die shrink, and spec for spec almost identical to the 950, the 1060 3GB is incredibly appealing.

> "Unless you absolutely cannot live without FreeSync, there is no justifiable reason to run with an AMD card."

GRAPHICS CARDS BENCHMARKS

HIGH-END 4K GPUS	VRAM	TOTAL WAR: ATTILA	FAR CRY PRIMAL	THE DIVISION	RISE OF THE TOMB RAIDER	POWER DRAW IDLE	POWER DRAW LOAD	3DMARK: FIRE STRIKE ULTRA (DX11)	3DMARK: TIME SPY (DX12)	PRICE
NVIDIA TITAN XP	12GB GDDR5X	16/29	54/62	35/61	12/32	49	365	7,166	9,097	$1,950
NVIDIA GTX 1080 TI REFERENCE	11GB GDDR5X	14/27	51/56	39/55	11/29	47	354	6,587	8,307	$1,130
AMD RADEON RX VEGA 64	8GB HBM 2.0	9/16	36/43	22/43	13/20	66	403	5,241	6,758	$899
PNY GTX 1080 XLR8 OC	8GB GDDR5X	9/19	39/43	26/41	8/20	53	334	5,077	6,597	$899
ASUS ROG STRIX GTX 1080	8GB GDDR5X	9/20	40/44	21/43	8/22	49	325	5,339	6,892	$899

MID-RANGE 1440P GPUS	VRAM	TOTAL WAR: ATTILA	FAR CRY PRIMAL	THE DIVISION	RISE OF THE TOMB RAIDER	POWER DRAW IDLE	POWER DRAW LOAD	3DMARK: FIRE STRIKE ULTRA (DX11)	3DMARK: TIME SPY (DX12)	PRICE
AMD RADEON RX VEGA 56	8GB HBM 2.0	21/31	58/69	42/67	22/36	64	331	8,656	6,263	$749
NVIDIA GTX 1080 REFERENCE	8GB GDDR5X	23/40	65/77	39/73	16/42	48	252	9,371	6,537	$800
MSI GTX 1070 GAMING X 8G	8GB GDDR5	23/36	55/65	47/63	14/35	53	306	8,221	5,753	$699
NVIDIA GTX 1070 REFERENCE	8GB GDDR5	21/34	53/62	34/59	13/33	47	288	7,805	5,542	$590
SAPPHIRE RADEON RX 580 8GB	8GB GDDR5	19/25	40/48	25/49	11/26	59	297	6,033	4,515	$499

BUDGET 1080P GPUS	VRAM	TOTAL WAR: ATTILA	FAR CRY PRIMAL	THE DIVISION	RISE OF THE TOMB RAIDER	POWER DRAW IDLE	POWER DRAW LOAD	3DMARK: FIRE STRIKE ULTRA (DX11)	3DMARK: TIME SPY (DX12)	PRICE
GIGABYTE AORUS RX 570 4GB	4GB GDDR5	24/31	45/56	32/56	7/33	66	268	10,243	3,833	$369
ZOTAC GTX 1060 AMP EDITION	6GB GDDR5	26/38	53/66	31/60	15/38	53	225	10,959	4,158	$385
EVGA GTX 1060 3GB SC GAMING	3GB GDDR5	24/36	49/61	31/55	9/35	47	251	20,251	3,905	$329
ASUS ROG STRIX GTX 1050 TI 4GB	4GB GDDR5	14/23	34/43	19/36	9/23	52	216	7,042	3,209	$279
EVGA GTX 1050 TI SC GAMING 4GB	4GB GDDR5	13/22	32/40	17/36	9/23	43	201	7,012	3,188	$259

MOTHERBOARDS

HIGH-END

$579 | WWW.ASUS.COM/AU

ASUS Prime X399

If you're going with the mighty powerhouse of Threadripper, you need a suitable motherboard. We admit, there's not a huge selection of X399 'boards out there right now (seven in total), so pickings are slim, but that's not to say there's no choice to be had.

In our opinion, ASUS's Prime X399 is ideal. For this number of cores, unless you have very specific needs (overclocking, more PCIe SSDs, specific storage solutions, and so on), there's very little to justify investing in a pricier 'board.

The Prime X399-A was the board we chose for our recent workstation rendering machine, because of these very reasons (see issue 447, page 90). We wanted to keep an eye on the price, yet still have access to a fantastically smooth BIOS for additional tweaking, overclocking, and more if we needed it. Throw in the gorgeously understated colour scheme and design of the board, plus cooling and storage support, and it's an all-round no-brainer.

That said, one of the biggest reasons we chose this board is due to market share. ASUS has loads of money and resources to invest in BIOS development, pushing the boundaries of memory support in the process – which is still key to unlocking the real potential of AMD's potent processor. Stability is also an important factor, and you can max both of those factors out here. Throw in the strong feature set and raw power and it's an easy recommendation to make.

MID-RANGE

$399 | WWW.ASUS.COM/AU

ASUS RoG Maximus X Hero

We haven't had chance to play with a lot of Z370 motherboards yet (we have some seriously juicy ones coming up next issue), because as this issue goes to press, Coffee Lake has only just dropped. That said, it's hard to argue with the ASUS RoG Maximus Hero's heritage. We've been using this lineup of motherboards in our test benches since Devil's Canyon and Z97.

The ASUS RoG Maximus X Hero is a fantastic update to the series, featuring an integrated rear I/O cover, oodles of USB ports, BIOS reset switches, Ethernet ports, integrated Wi-Fi, dependable audio, a ton of onboard storage support, M.2 heatsinks and more. One of the things we've already touched upon with our love for ASUS is just how easy it is to use the UEFI BIOS. It may be difficult to quantifiably review a BIOS, because those familiar with one manufacturer's BIOS will almost always know how best to take advantage of that compared to another, and it's often personal preference that dictates the issue; however, the placement of menus, along with the options and items you can tweak in ASUS's BIOS make it one of the more intuitive and easy-to-use that we've seen in the last few years.

This 'board is a touch on the pricey side, but if you're looking to shell out on a high-end Coffee Lake processor, it's well worth the investment.

BUDGET

$169 WWW.GIGABYTE.COM.AU

Gigabyte AB350 Gaming 3

Now we turn to our budget-specced motherboard of choice: the Gigabyte AB350 Gaming 3. Ryzen is an absolutely revolutionary product, chipset and all. Just how far it's shifted the processor industry is something we may never know for sure, but the fact that you can now invest in a quad-core i5 equivalent for less than $200 certainly makes it a force to be reckoned with.

Couple Ryzen with Gigabyte's fantastically well-designed AB350 Gaming 3 and you're quickly on your way to speccing out one hell of a budget rig. Gigabyte has long impressed us with just how much it can cram on to a motherboard, while still hitting aggressive price points, and the plucky underdog often wins our motherboard group tests, purely because of its crazy design ethos.

There's a whole heap of motherboards available for Ryzen at this point – however, if you're after a no-fuss, plug-and-play build, the AB350 is where it's at.

This board isn't for tweakers – you won't be able to overclock on it – but it does provide you with everything you'll need to support multi GPUs, PCIe storage, USB 3.1 and more. It even supports memory up to 3,200MT/s as well, meaning you can net yourself a 10–15% increase in performance in some cases, just by turning on the AMD memory profiles.

RAM

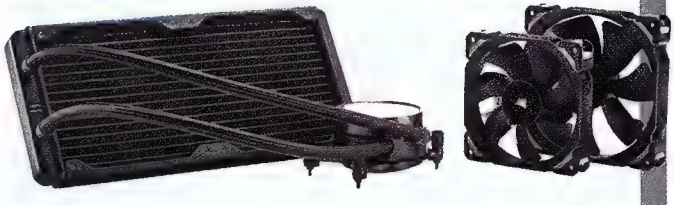
Corsair 32GB Dominator Platinum 2,400MHz

$479 WWW.CORSAIR.COM

It isn't a great time to upgrade memory right now. Not because there's no benefit in giving your OS and apps more room, but because pricing is currently horrible. Memory pricing has almost doubled in the last 12 months, so while we'd love to recommend that everyone aims for at least 16GB in their systems, it's a tough call to make when even a budget kit will set you back nearly $250.

Aim for 8GB as an absolute minimum for most normal use, although 32GB is nice for serious work. If you've got room to double-up on what you've already got, do so, because hopefully pricing will calm down by the time you upgrade again. When it comes to what to buy, aim for capacity first and frequency after. Low latency kits are the way to go if you can afford them, although given the current inflated pricing, being picky will cost you. As an example, you can pick up DDR4 kits rated at up to 4,600MT/s (PC4 36800 with 19-23-23-43 timings), although you will pay a lot for the privilege ($550-plus for 16GB).

It's worth noting that Ryzen benefits from faster memory, because its infinity fabric operates at the speed of the memory, but be mindful of compatibility — check your mobo's supported memory list for capacity and speed first.



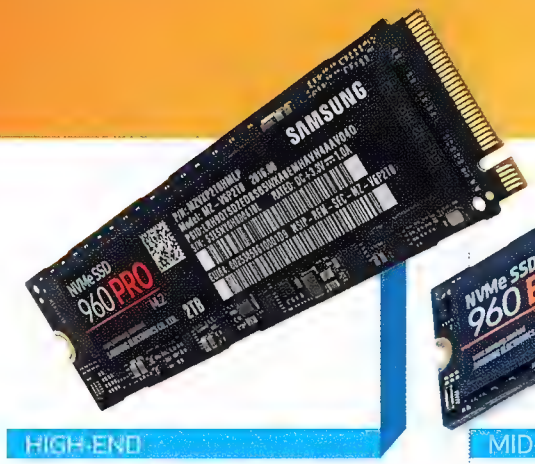
CPU COOLERS

NZXT Kraken X62

$239 WWW.NZXT.COM

If cash is tight, there's nothing wrong with using the cooler that comes with your CPU (as long as it's the retail version — OEMs don't have coolers). However, if you want to overclock, or keep temperatures down so your machine runs more quietly, water cooling gets the nod from us. Obviously, piecing together your own loop is the pro choice here, although for an easier life, an all-in-one cooler has a lot going for it. We've seen quite a few of these recently as new manufacturers enter the market, but the likes of the Corsair H110 ($169) and NZXT Kraken X62 ($239) still stand out as the ones to buy.

SOLID-STATE DRIVES



HIGH-END

$450–$1,799 | WWW.SAMSUNG.COM/AU

MID-RANGE

$189–$599 | WWW.SAMSUNG.COM/AU

BUDGET

$190 | WWW.CRUCIAL.COM

Samsung 960 Pro

No-brainer time: if you want the fastest storage around, you'll want an SSD. Not just any SSD either – you'll want a PCIe M.2 drive that is capable of producing the kind of transfer rates that make grown system admins weep. And at the top of that pile of drives at the moment is Samsung, with its 960 Pro range of M.2 drives, where you'll see sustained transfer reads and writes of 3,400MB/s and 2,100MB/s, respectively. The random 4K performance is no slouch either, hitting 57MB/s and 194MB/s when throwing around smaller files.

You'll notice that we haven't specified a capacity with our recommendation, and that's because we suggest getting the biggest drive you can afford, without getting silly; $450 will net you a fairly sizeable 512GB model, which is more than enough for your OS and your main applications. Jumping up to a 1TB drive means you can hold a good chunk of your data on the drive as well, with the pricey 2TB model allowing for serious data usage.

Samsung 960 Evo

Samsung is the go-to company for high-end SSDs, but it's also our recommendation for the mid-range. The 960 Evo mixes a lot of the same magic as the 960 Pro, but at a lower price. The big difference is the type of NAND used. The 960 Pro uses MLC (multi-level cell) flash, while the Evo uses TLC (triple-level cell). They're both 3D NAND architectures, but the Pro manages to squeeze more into the same space, which is why it's available in larger capacities – while the Evo ships at 250GB–1TB.

Performance-wise, there is a difference between the Pro and Evo, but it isn't huge—sustained reads and writes of 3,200MB/s and 1,800MB/s aren't too far off the Pro. In fact, there are benchmarks that can see the Evo ahead of the Pro. It's worth noting that the 960 Pro does have a five-year warranty (or 800TB written), while the 960 Evo only has a three-year warranty (or 400TB written).

Crucial BX300 480GB

Once you've used an M.2, you can't go back. To be fair, that's not strictly true, but it's a good sound bite, and there are some transfers where you can notice the difference. Not every system has access to M.2, though, and even those that do tend to be limited to one or maybe two slots. M.2 drives also demand a slight premium over 2.5-inch SSDs. That means there is still a market for the more traditional SSD, and such drives are still the go-to upgrade for anyone who is still running a spinning hard drive.

The Crucial BX300 is our new favourite budget SSD, packing half a terabyte for a wallet-friendly $190. As with any modern SSD, performance is decent enough, although you'll find that the straight throughput of any SSD that uses SATA is ultimately limited by the interface. You can check out the full review of this new drive on page 22.

HARD DRIVES

HGST Ultrastar He10

$719
WWW.HGST.COM

How much storage do you really need? We're assuming you have some form of network attached storage, a good sized SSD, plenty of backup options, and a healthy chunk of online storage, like any good setup. So what's left?

Some extra space is nice, sure, but unless you have specific requirements, a 1TB, 2TB or 4TB hard drive is probably all you need, and will set you back $100–$300. You can now pick up hard drives up to 12TB, although they cost over $800. This 10TB model is a little more reasonable.

CASES

HIGH-END

$289 | WWW.PHANTEKS.COM

Phanteks Enthoo Evolv TG

Cases are inevitably a very personal thing for many people. After all, a big factor is aesthetics. Whether you care can dictate how much you're willing to spend. Looking for a super-slick, clean build? Then it's likely you're hunting for a svelte, aluminium, tempered glass solution. Couldn't give a damn? A square tin can sans window will do the job just fine.

That said, if you're building a premium system, you can't go wrong with a premium chassis. Ease of building, materials, paint finish and internal cable routing options all contribute to a happier enthusiast.

For us, all this is epitomised by Phanteks — the Dutch company has a knack for making the premium affordable, and nowhere is this more apparent than the Phanteks Enthoo Evolv TG. Featuring 4mm thick aluminium, tempered glass and a sandblasted finish, combined with extensive cooling and storage support, it's definitely one of the best chassis out there for any custom system.

MID-RANGE

$159 | WWW.FRACTAL-DESIGN.COM

Fractal Design Meshify

Another one of our favorite case manufacturers is Fractal Design. Although typically catering more toward the no-fuss, silent, budget-oriented options with its Define series, Fractal provides a plethora of more exotic styled, cooling-heavy cases for those tempted into the realms of custom PC perfection, all without breaking the bank.

This is a perfect example: a small, stylish, mid-tower design, developed with maximum airflow in mind. The 3D diamond mesh front panel lends itself to up to 360mm radiators, and although liquid cooling isn't the best solution, it's perfect for AIOs and smaller form factor builds. Despite its low price, it supports up to three 2.5-inch SSDs on the rear of the motherboard tray, two 3.5-inch hard drives below the PSU cover, and a full-sized ATX PSU. Couple that with the inclusion of fan filters, solid cable management, and a smoked glass side panel, and you may wonder where the corners were cut when designing this beauty. We'll let you know... if we find them.

BUDGET

$89 | WWW.CORSAIR.COM

Corsair Carbide 270R

Yes, $90 is a fair amount of cash when building a budget rig. We usually recommend you try to save as much money as you can on parts — apart from your PSU, CPU, GPU and RAM. After all, you won't gain much from a case upgrade compared to those four components.

But if you're looking for a cheeky cheap upgrade, nothing's more satisfying than upgrading that old hunk of metal in which you house your precious hardware. Corsair's Carbide 270R hits that mark perfectly. With a simple, elegant design, the 270R would look as at home in a bedroom as in a game dev's studio. With support for up to three 120mm fans in the front, two 140mm ones in the roof, and four hard drives, it's not that different from the more expensive Fractal Design Meshify.

It's not perfect, but for the cash, you'd be hard pushed to find better than Corsair's aggressively priced, budget-busting box.

DISPLAYS

ASUS PA329Q

$1,999
WWW.ASUS.COM.AU

Recommending a display is tricky because there are so many subjective variables. What may be perfect for one may not work for you (as we explained in LCD tech head-to-head, page 18). Most of us want the best of all worlds — which tends to mean IPS panels, although newer tech is blurring these lines. Add in screen sizes, native resolutions, FreeSync/G-Sync, high dynamic range and more, and it's clear that recommending a screen is difficult. We're still searching for the 'perfect' panel at a price we're comfortable with — the ASUS PA329Q is great, but at $1,999, it's not for everyone.

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macOS High Sierra

50 ESSENTIAL TIPS
Master your Mac

Craig Grannell delves into High Sierra, revealing all the best new features that can help improve your Mac experience.

There are two sides to macOS High Sierra. Apple first talks about new technologies at the very heart of the system. These are designed to make your Mac more capable and reliable. They lay foundations for the future, and offer great potential – in some cases, enabling entirely new apps to be created by brilliant developers – while making present tasks faster.

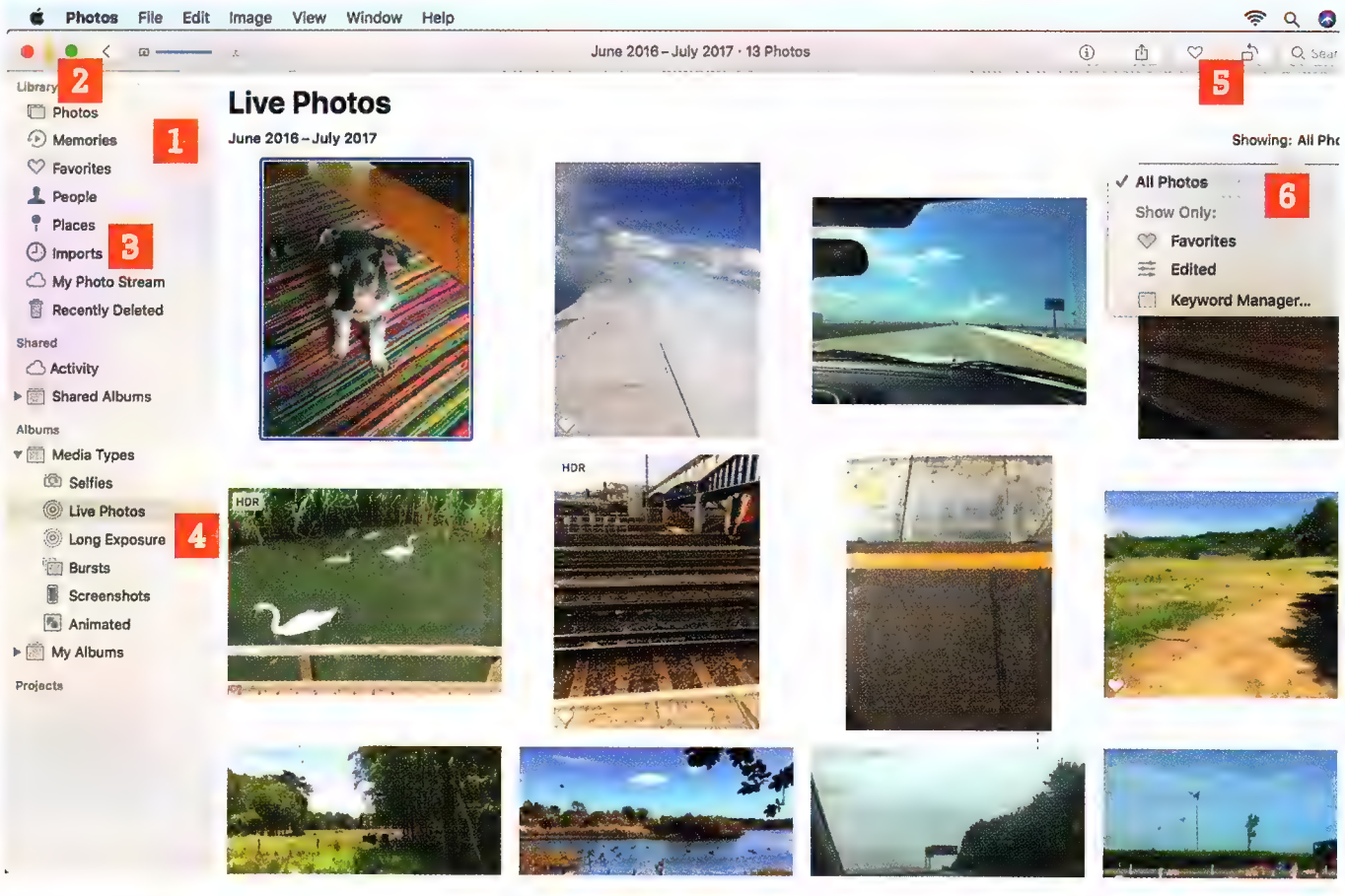
The other side to High Sierra is all about Apple refining existing features and apps. In some cases, these are small tweaks – the ability to pin a note in the Notes app, the means to compose Mail in Split View when in fullscreen and the odd addition to a System Preferences pane. Doubtless, though, even such relatively small changes can make a big difference to people who use these applications and settings every day.

And there are plenty of bigger changes. Safari now enables you to customise websites on an individual basis, rather than you adjusting the likes of Reader and page zoom levels as you browse. And the update to Photos makes it almost feel like a new app, due to a revamped interface, and a superb update to its editing tools. If you've ever wanted to do more with Live Photos, or get more precision control over colour within your snaps, now you can.

Over the following pages, we'll highlight all the great things that we've discovered in macOS High Sierra, and a smattering of features you may not know existed. Dig in, and they should make you a master of your Mac.

MACOS HIGH SIERRA: 50 EXPERT TIPS AND TRICKS

Browse your collection, edit Live Photos and delve into new adjustment features.



EXPLAINED... THE PHOTOS INTERFACE

1 THE NEW SIDEBAR
The sidebar in macOS Sierra was optional ('View > Show Sidebar'), but now it's persistent. If you always want it in fullscreen, too, turn on 'View > Always Show Toolbar and Sidebar in fullscreen'.

2 YOUR LIBRARY
Key custom albums that were previously scattered around the sidebar are now housed under Library. Here, you find the likes of Memories and Favourites, along with the Recently Deleted album.

3 REVAMPED IMPORTS
Click on Imports for a chronological feed of photos and images you've added to Photos. Note these are grouped by import and not date, and so the likes of Photo Stream entries show up individually.

4 NEW MEDIA TYPES
Under Albums in the sidebar, you'll find a Media Types folder, which provides fast access to specific types of images, such as screenshots, selfies and the new long exposure option (from Live Photos edits).

5 QUICKER EDITING
In macOS Sierra, you could rotate or favourite a selection of snaps using menu options, but now there are bespoke buttons in the toolbar for doing so. The selection number is much clearer, too.

6 FILTER OPTIONS
Enter a library category and you'll see a Showing filter menu. This defaults to All Photos. Click it to limit the view to only specific image types, or images that match user-defined keywords.

IT'S ALL IN THE EDIT

1 SILENCE LIVE PHOTOS
Double-click a Live Photo and click Edit to access the editing view. Here, you can use the two buttons at the bottom left of the window to, respectively, turn off the Live Photo (circular icon) or just mute its audio (speaker icon).

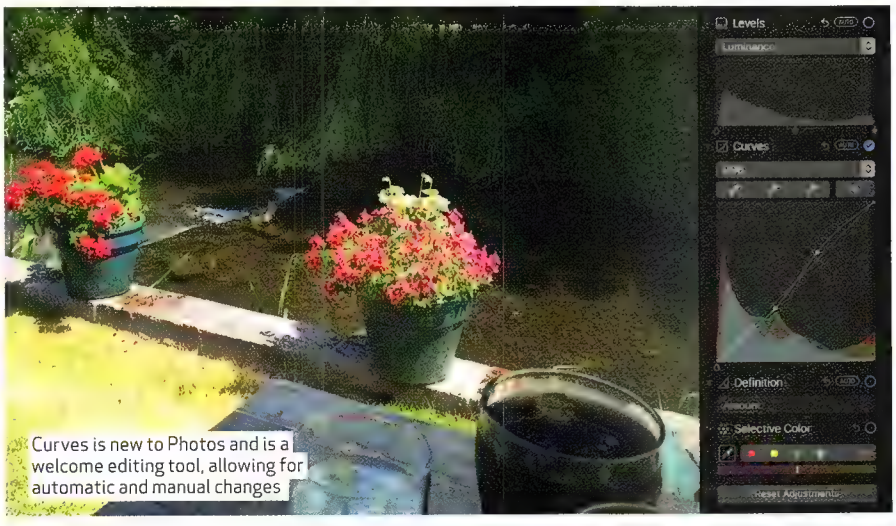
2 TRIM LIVE PHOTOS
Below your Live Photo, you'll see a filmstrip common to video editing apps. Drag the drag handles to trim the Live Photo's video component. You can also click a frame and then click 'Make Key Photo' to change what's shown when the image is still.

3 BOUNCE AND LOOP
A standard Live Photo defaults to the Live option in the menu to the right of the trim controls. But you can switch the animation type to Loop (endlessly repeats) or Bounce (animates back and forth). Use Long Exposure to fake a long exposure shot.

4 MAKE ADJUSTMENTS FASTER
In macOS Sierra, editing in Photos was stripped back. On clicking Adjust, only a few options were shown; you had to manually add more. In macOS High Sierra, this has changed. Adjust is a scrolling pane of collapsible sections, all of which are immediately available – and this is far more usable.

5 EXPLORE FILTERS
In all honesty, Photos isn't necessarily the best place to go if you're looking for the world's most amazing filters, but they've at least been shaken up a bit in macOS High Sierra. Chrome, Process, Transfer and Instant have all gone, replaced by filters badged Vivid and Dramatic, both of which have Cool and Warm variants.

6 WORK WITH CURVES
The Curves tool is new to Photos. Click Auto and Photos will automatically improve your image. You can manually drag points, and add new ones by clicking on the curve. Try fashioning a subtle S-curve to make your colours really pop.



Curves is new to Photos and is a welcome editing tool, allowing for automatic and manual changes

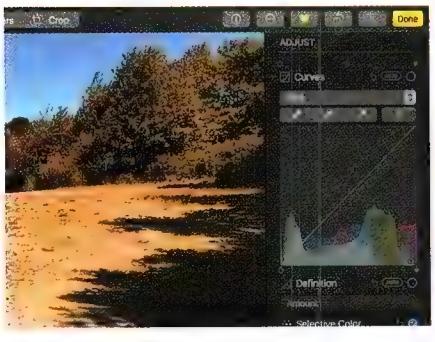
Use other apps

One of the big changes to Photos is the way in which it interacts with other apps. Although Photos now has improved editing tools, they still fall short of what you get in the likes of Photoshop or Pixelmator. But now you can use the 'Image > Edit With' menu (also available in the contextual menu) to send your image to a third-party editor.

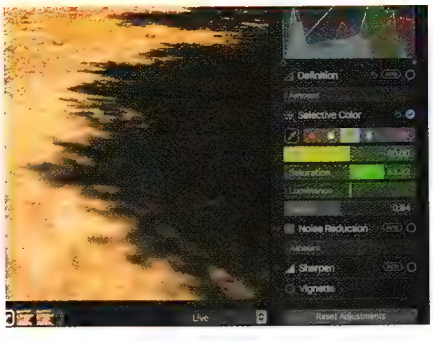
In theory, changes made should be saved in your Photos library. Edits can also be reverted by going into the editing view and clicking 'Revert to Original'. However, do test on copies of precious photos ('Image > Duplicate' or 'Command-D' on a selected image), just in case.

HOW TO:

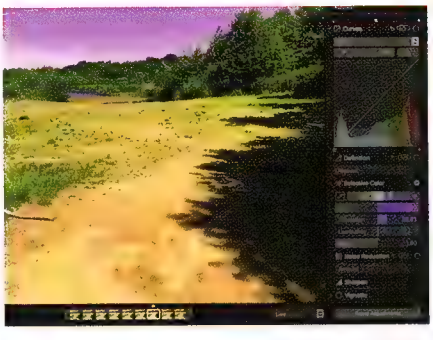
Use Selective Colour in Apple Photos



1 ADJUST A COLOUR CHANNEL
Open a photo with greenery and a sky in the Photos edit view. Scroll down to Selective Colour. Select the green colour channel, and drag Hue all the way to the left. Notice how this shifts the greens towards red, making for an autumnal look.



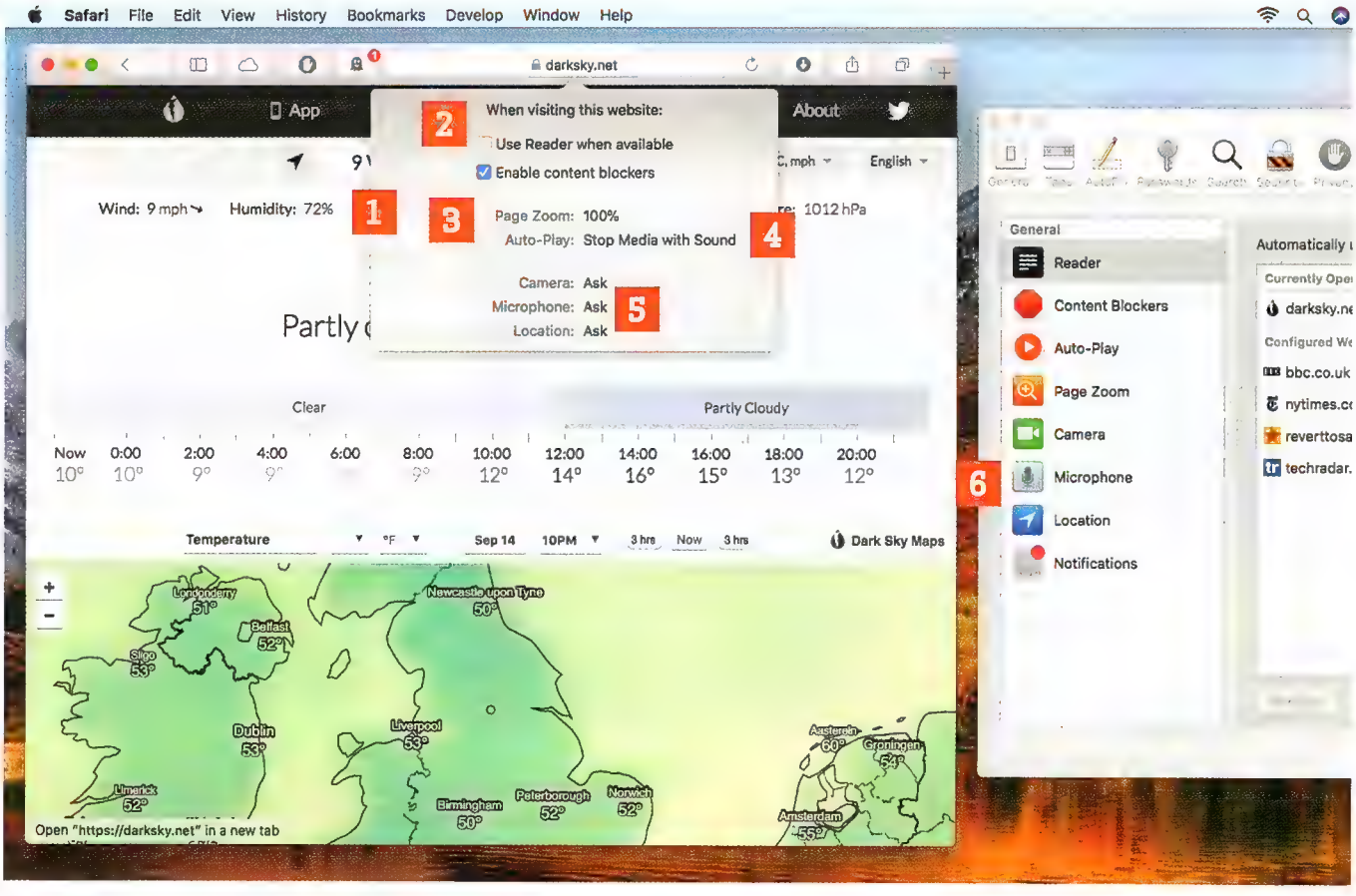
2 AMEND THE RANGE
Use the Range slider to adjust the range of colours over which your adjustment is applied. Nudge it left to soften the effect, or right to increase it. Experiment with Saturation to amend the intensity of the colour selection.



3 USE A CUSTOM HUE
If you want to alter a specific colour, select it with the eyedropper tool, and then adjust settings accordingly. Click on the sky and maximise Hue for a freaky alien purple sky. (Perhaps be subtler on your own pics!)

MASTER SAFARI IN HIGH SIERRA

Make every website work in the way you want it — eradicate auto-play videos, tracking and more.



EXPLAINED... BROWSE ROUND THESE IMPROVEMENTS

1 WEBSITE SETTINGS
On visiting a website, go to 'Safari > Settings for This Website'. A pop-up will appear under the address bar, giving you a number of settings you can tweak specifically for that particular website.

2 READER VIEW
Reader view strips all the cruft from the websites you visit, leaving only the text and images on the page. Previously, it had to be manually triggered each time you needed to use it. Now, you can have it automatically activate on compatible web pages.

3 PAGE ZOOM
Safari has always enabled you to zoom the content of the current tab, but now you can set a zoom level on a per-site basis – ideal if you find a favourite site has text that's a bit too small or large to read.

4 AUTO-PLAY
By default, Safari will stop all media on a web page that's got sound. You can override this setting by allowing auto-play. Alternatively, go further and stop all distracting auto-playing content.

5 PERMISSIONS
Some sites require permissions to your Mac's camera, microphone or location. In each case, you can use the relevant menu to decide whether you're happy to give such permissions (Allow) or not (Deny).

6 PREFERENCES
Safari's preferences have been updated to cope with these new settings. In place of the Notifications tab is the Websites one, with configuration sections for everything mentioned in the other steps.

BEND SAFARI TO YOUR ~~LIKING~~ WILL

1 TURN STUFF ON
Safari minimises URLs and doesn't preview where links go. Change this by 'View > Show Status Bar' (to display link targets on hover) and 'Show full website address' in the Advanced preferences (so you get more than a domain in the address bar).

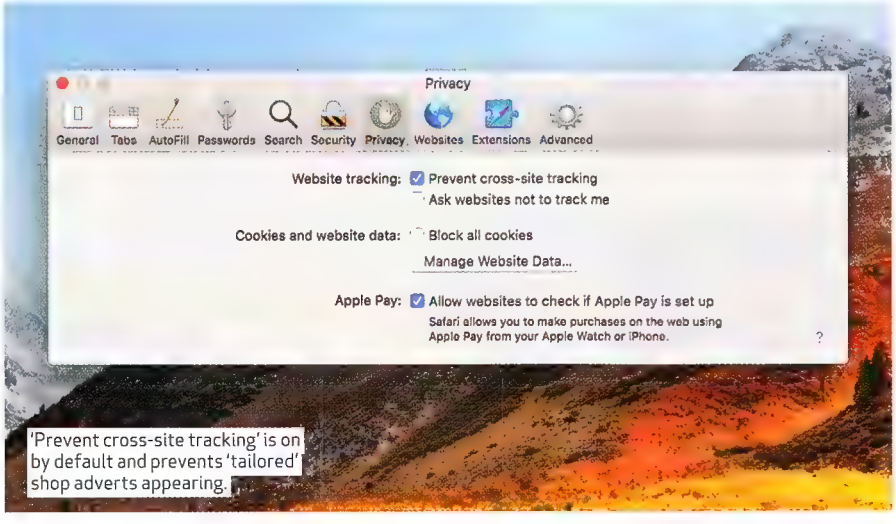
2 TAME NOTIFICATIONS
Websites increasingly ask to bug you with push notifications. Generally, avoid allowing them to do so. If one is continually flinging notifications your way, you can disable them in the Notifications category within Safari's website preferences.

3 EDIT WEBSITE SETTINGS
In the Websites section of Safari's preferences, select one of the categories from the sidebar. You'll see settings for currently open websites and also closed but configured ones. These can be adjusted using the menus, without visiting the sites in question.

4 SET GLOBAL DEFAULTS
At the bottom of the Websites tab (excepting the Notifications category) is a menu labelled 'When visiting other websites'. Use this to set a default for websites you've not manually configured – for example, to have Reader activate by default on all sites, unless otherwise stated.

5 PREVENT TRACKING
In the Privacy section of Safari's preferences is the new 'Prevent cross-site tracking' setting. On by default, it stops advertisers following you around the internet. So no more shop adverts appearing everywhere after you briefly check out something of interest.

6 USE EXTENSIONS
This isn't new to macOS High Sierra, but it's worth investigating the Extensions tab in Safari's preferences. From here, you can add useful functionality to Safari, such as web clippers, alternate search engines, security add-ons and more.



'Prevent cross-site tracking' is on by default and prevents 'tailored' shop adverts appearing.

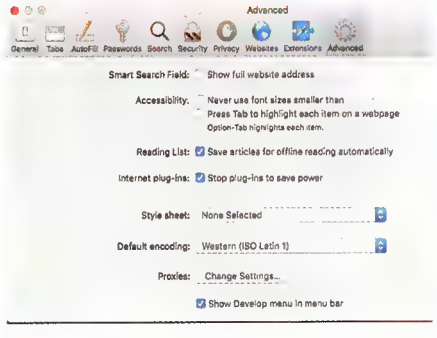
Configure Reader

The idea behind Safari Reader is to make the internet more readable. The view strips everything from a web page, apart from text and embedded imagery. If you find elements of a site's design distracting or the text is hard to read, activate Reader.

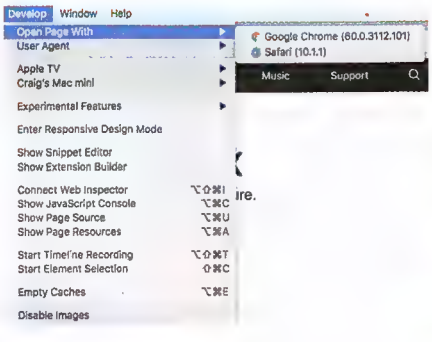
When the view is running, click AA in the address bar to bring up options. The two buttons at the top adjust the text size, and the four coloured discs enable you to switch themes. There are also eight different fonts to choose from.

Be mindful that all choices work throughout Safari — they cannot be set on a per-site basis (unlike merely activating Reader).

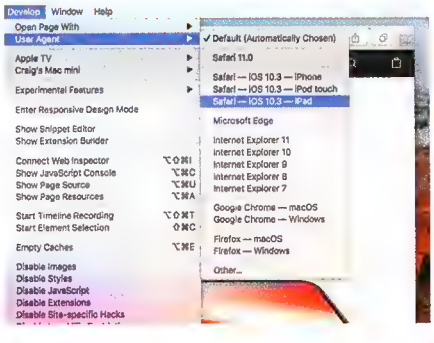
HOW TO:
Use the Develop menu



1 TURN IT ON
If a site claims you need another browser or device to use it, the Develop menu may enable you to circumvent the roadblock. Activate it in the Advanced section of Safari's preferences (check 'Show Develop menu in menu bar').



2 SWITCH BROWSERS
If you've installed another browser, it will be listed in 'Develop > Open Page With', alongside Safari. Select the browser and the current web page will be sent to it. Note that login details won't go along for the ride.



3 SPOOF A BROWSER
Go to 'Develop > User Agent' to have Safari pretend to be another browser. This is useful for when a mobile version of a site will play video, but the desktop version still requires you to install Flash, like you're living in 2005.

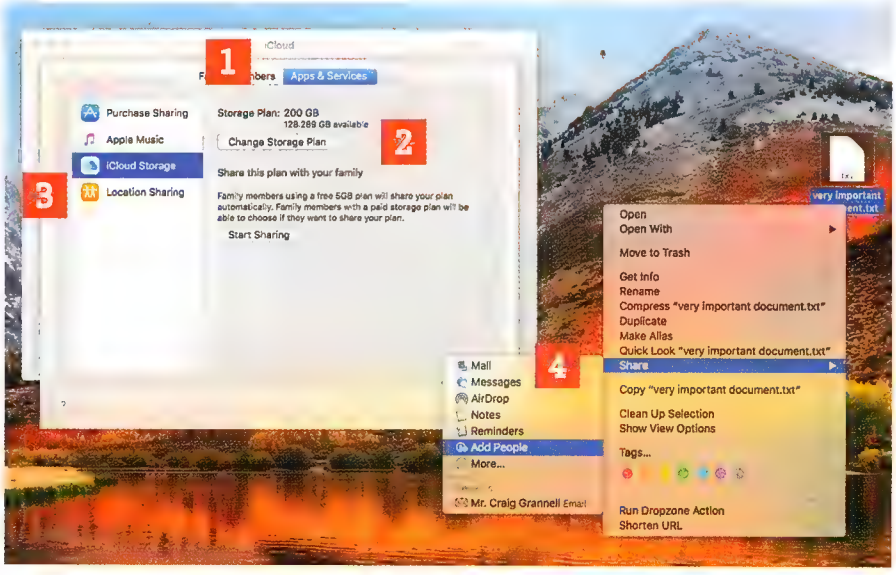
DRILL DOWN INTO SYSTEM PREFERENCES

Manage family accounts, share files using iCloud and change the macOS High Sierra desktop picture.

1 FAMILY MEMBERS
Click in the iCloud pane in System Preferences, and then click Manage Family. In the Family Members tab, you can add other members of your family to a sharing account. Once their details are entered, you'll all be able to share (most) purchased apps, games, books and music.

2 ICLOUD STORAGE
In the Apps & Services tab, click on iCloud Storage. Under macOS High Sierra, you can now share a plan with your entire family. This makes the 200GB and 2TB tiers a good bet – one of those should be enough space for everyone's back-ups and documents.

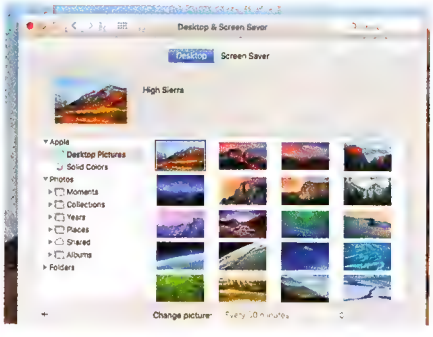
3 LOCATION SHARING
It's been possible for a long while to share location information with others on iOS, using the likes of Find My Friends. Now on the Mac, click Location Sharing, and you can decide which family members you'd like to share your location with.



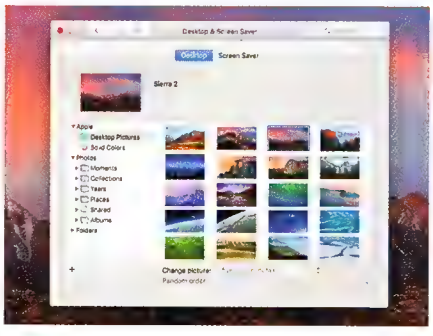
4 SHARE A FILE
As of macOS High Sierra, individual files can also be shared via iCloud – and more than in the old sense of 'send it to someone'. Control-click and go to 'Share > Add People' and you can invite other people to access – and edit – your document.

HOW TO:

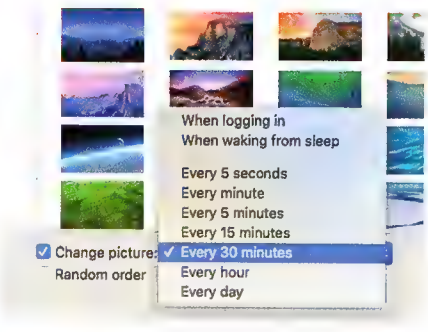
Adjust your desktop background



1 FIND YOUR DESKTOPS
The second you launch macOS High Sierra, you'll see it has a brand-new desktop background. If you're not keen, you can change it. In System Preferences, go to Desktop & Screen Saver. You'll see High Sierra selected.



2 CHANGE THE BACKGROUND
If you fancy using a background from an older version of macOS or OS X, simply click on it. (Unfortunately, our favourite is no longer available.) Alternatively, select from Solid Colours or Photos for a custom image from your own collection.



3 DRAG AND DROP
You can also adjust the desktop background by dragging and dropping an image from Finder to the 'well' in the System Preferences pane. Fancy shaking things up more often? Tick the Change picture and Random order boxes.

NIFTY LITTLE UPDATES IN THE NOTES APP

Two welcome changes come to Notes: adding tables to documents and pinning favourites.

EXPLAINED... NEW IN NOTES

1 NOTES TABLES
Click the Table button in the Notes toolbar — or use 'Format > Table' — and a table will be added to your note at the cursor's current location. You can add multiple tables to a single note — you needn't stick at one.

2 TABLE FORMATTING
Tables in Notes start off two cells tall and two cells wide. To change the setup, Control-click the column or row widget, and use the Add and Delete options accordingly. Note you don't get headers — just standard cells.

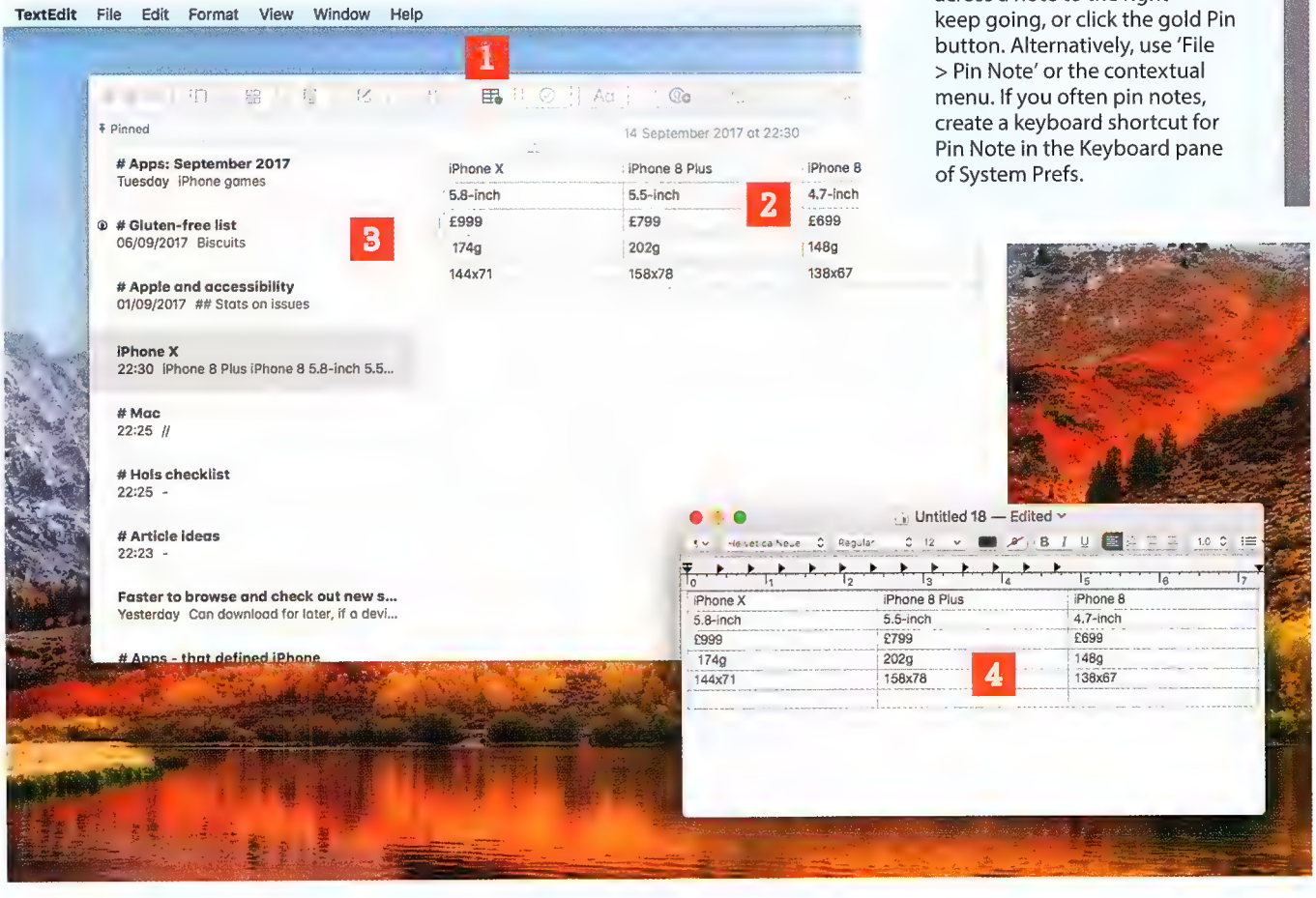
3 COLUMNS AND ROWS
Columns and rows in Notes can be rearranged. Click inside a cell and then click-drag the relevant column or row widget. Be aware that you can only move columns or rows to a different point within the same table.

4 COPYING TABLES
Copy and paste isn't entirely intuitive with Notes tables, and results can vary across apps. For best results, click-drag around the table, so it's highlighted in blue. It'll then paste cleanly into Mail and text editors.

Perform actions on notes

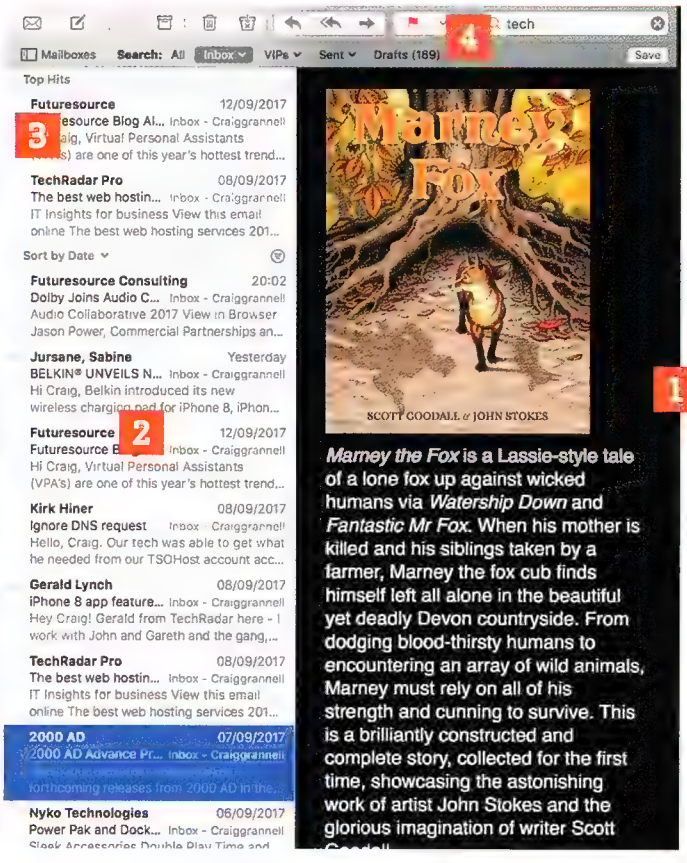
In Sierra, you could two-finger swipe across a note to show a delete button (and continue dragging to delete the note). In High Sierra, the leftwards swipe still brings up the red delete button, but it's joined by a grey lock button. Locking a note stops it from being edited. This action previously required a menu action.

New to High Sierra is the ability to pin a note to the top of the list. Two-finger swipe across a note to the right — keep going, or click the gold Pin button. Alternatively, use 'File > Pin Note' or the contextual menu. If you often pin notes, create a keyboard shortcut for Pin Note in the Keyboard pane of System Prefs.

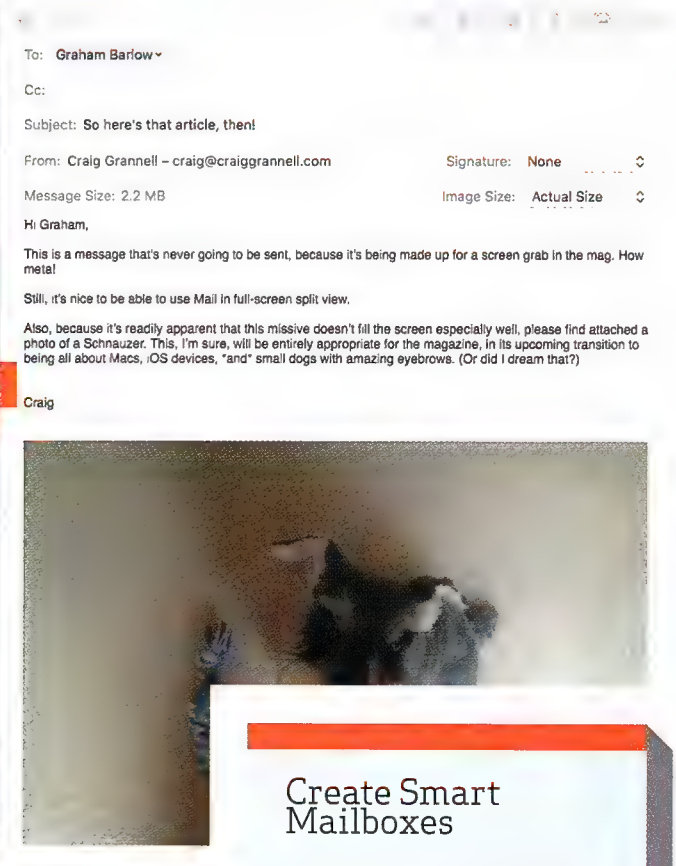


MASTER THE HANDY CHANGES IN APPLE MAIL

Don't miss Mail's trio of new features in macOS High Sierra — and two old classics that can save you time.



Marney the Fox is a Lassie-style tale of a lone fox up against wicked humans via *Watership Down* and *Fantastic Mr Fox*. When his mother is killed and his siblings taken by a farmer, Marney the fox cub finds himself left all alone in the beautiful yet deadly Devon countryside. From dodging blood-thirsty humans to encountering an array of wild animals, Marney must rely on all of his strength and cunning to survive. This is a brilliantly constructed and complete story, collected for the first time, showcasing the astonishing work of artist John Stokes and the glorious imagination of writer Scott



EXPLAINED... CLEAR COMMS

1 SPLIT VIEW
In macOS Sierra, Mail in fullscreen mode wouldn't easily let you compose an email and refer to your inbox. macOS High Sierra instead utilises its own Split View, with a tabbed compose area alongside your existing email.

2 SPACE SAVER
This isn't an improvement you can easily see, but changes to the way macOS deals with files means that your email should now take up less space. If you have tons of emails and are lacking in storage, this could be a godsend.

3 TOP HITS
Search in Mail is now faster, but also — more importantly — a bit smarter. The most relevant messages Mail finds are placed at the top of the list, as Top Hits. And the more you search, the smarter this new system gets.

4 INBOX SHORTCUTS
Just like Safari, Mail has a shortcuts bar ('View > Favorites Bar') to which you can drag often-used mailboxes. Along with affording you fast access through clicking them, they can be opened using Command and number keys.

Create Smart Mailboxes

Smart Mailboxes are mailboxes for which you define specific criteria, which are subsequently populated with matching email. Rules can be time-based — you can create a mailbox that houses the email you received over the past week. Or one to include older email that's languishing in your inbox to be dealt with. Label it something useful like 'Deal with now'.

The VIP folder's handy for flagging emails from important people, but try combining 'Sender is VIP' and 'Message is unread' rules. That'll give you a smart mailbox with emails you haven't even looked at from senders you consider vital. Stash it in the Favourites Bar.

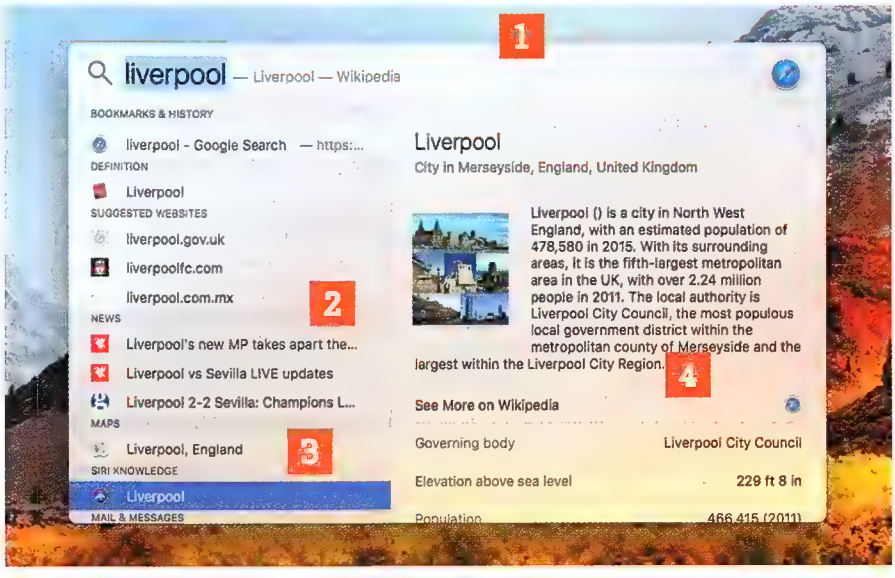
SHINE A LIGHT ON SEARCHES WITH SPOTLIGHT

Save yourself the hassle of rummaging around the web — or your Mac — for vital info and documents.

1 SPOTLIGHT CATEGORIES
Search results in Spotlight are a mix of content from the web and whatever macOS High Sierra finds on your Mac's drive (and in iCloud Drive). If you don't find certain categories useful, you can disable them in the Spotlight pane of System Preferences.

2 NEWS SOURCES
It's not going to replace a newspaper, but Spotlight now includes a news section for articles related to your search term. You get a synopsis for each article, and a link to the original online. It works pretty well for getting the latest on sports teams.

3 LOCATION MAPS
You can, of course, fire up Maps (or visit Google Maps in Safari) to find out where a place is. But type a location into Spotlight and it'll bring up a small map that'll give you the basics of where that place can be found – along with photos and further information.

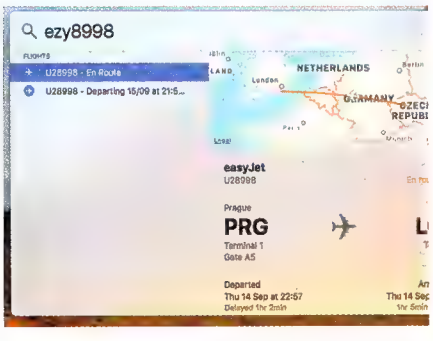


4 SIRI KNOWLEDGE
Under the rather vague heading of Siri Knowledge, you'll find what amounts to an expanded flash card about a given subject or term.

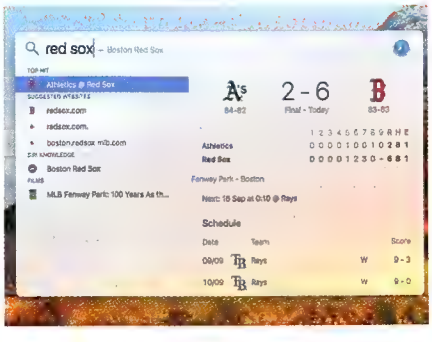
Mostly, imagery, info and stats are pulled from Wikipedia, but you also sometimes get links to other sites and the odd map. And it may dig up something surprisingly useful.

HOW TO:

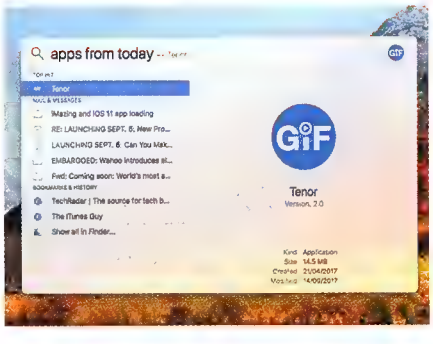
Find more stuff using Spotlight



1 GET FLIGHT INFO
If you punch a flight number into Spotlight, you'll gain access to one or more matching flights. Select one to see a status panel with map, gate details, arrival and departure times, and even whether bags are ready.



2 VIEW SPORTS RESULTS
Sports fans are increasingly well catered for by Spotlight. Type in a major team, be it for Premier League Football or your local NRL team, and you'll see a list of recent results and also an upcoming schedule.



3 DO TIME-BASED SEARCHES
Although still some way from a natural-language search tool, Spotlight can handle time-based searches. Try typing things like 'apps from this week' (for recent installs) or 'documents from July' and see what you get.

AND TAKE A LOOK AT THE REST...

Lots of other goodies are lurking in macOS High Sierra but not all of them are visible.

FACETIME PHOTOS

There are various hacky workarounds that allow you to save bits of FaceTime conversations to your Mac. Now, though, there's an official one from Apple. As you're chatting away to someone, you can click the camera shutter button to capture a special moment and save it as a Live Photo. The other person on the call is immediately notified that a photo was taken, and so this is all very much above board. The animated snap ends up in your Photos library.

If you're not keen on people being able to take such photos of you, it's possible to disable this functionality. In FaceTime's preferences on the Mac, untick 'Allow Live Photos to be captured during Video calls'. On iOS, the equivalent option is FaceTime Live Photos, which is found in the FaceTime section of the Settings app.

A SMARTER SIRI

Apple's rather proud of Siri's voice revamp in macOS High Sierra. Although the virtual assistant hasn't quite clambered out of the uncanny valley, Siri now sounds more natural and expressive, whether telling you the weather, or complaining that you haven't actually enabled Siri to use Location Services yet (as happened while writing this very feature – oops).

In macOS High Sierra, Siri's designs on being a personal DJ go up another notch. Already, you could ask Siri to "play some music" or start playing something by a specific artist. But now Siri can respond to moods and make recommendations – at least, if you're a subscriber to Apple Music. (If not, Siri curtly notes "I can't play music for a particular mood".)

Siri has one other trick in macOS High Sierra: if you nip into the Accessibility pane of System Preferences and select Siri (under Interaction), you can tick 'Enable Type to Siri'. Although primarily intended for people who cannot speak to Siri, it's a handy feature if you need to ask Siri something, are armed with headphones, and are in a place where you should really be silent. (Alternatively, if you want total silence in both directions, you can also have Siri respond without speaking, by turning off 'Voice feedback' in the Siri pane of System Preferences.)

VIRTUAL REALITY

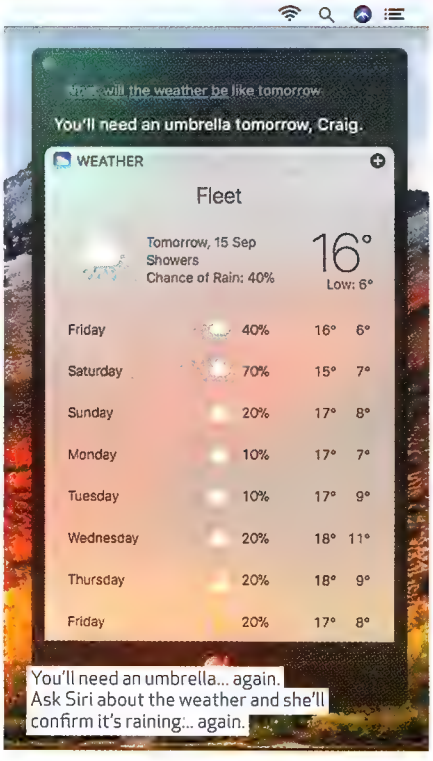
We're not quite in the Matrix just yet, nor hanging around with Johnny Mnemonic, but virtual reality is increasingly worming its way into the world of technology. As far as macOS High Sierra goes, you're not (yet) going to be creating virtual worlds on a MacBook. But if you're armed with a suitably powerful supported iMac (which, at present, means the new iMac with Retina 5K display), you can, in macOS High Sierra, fashion entire

AFPS

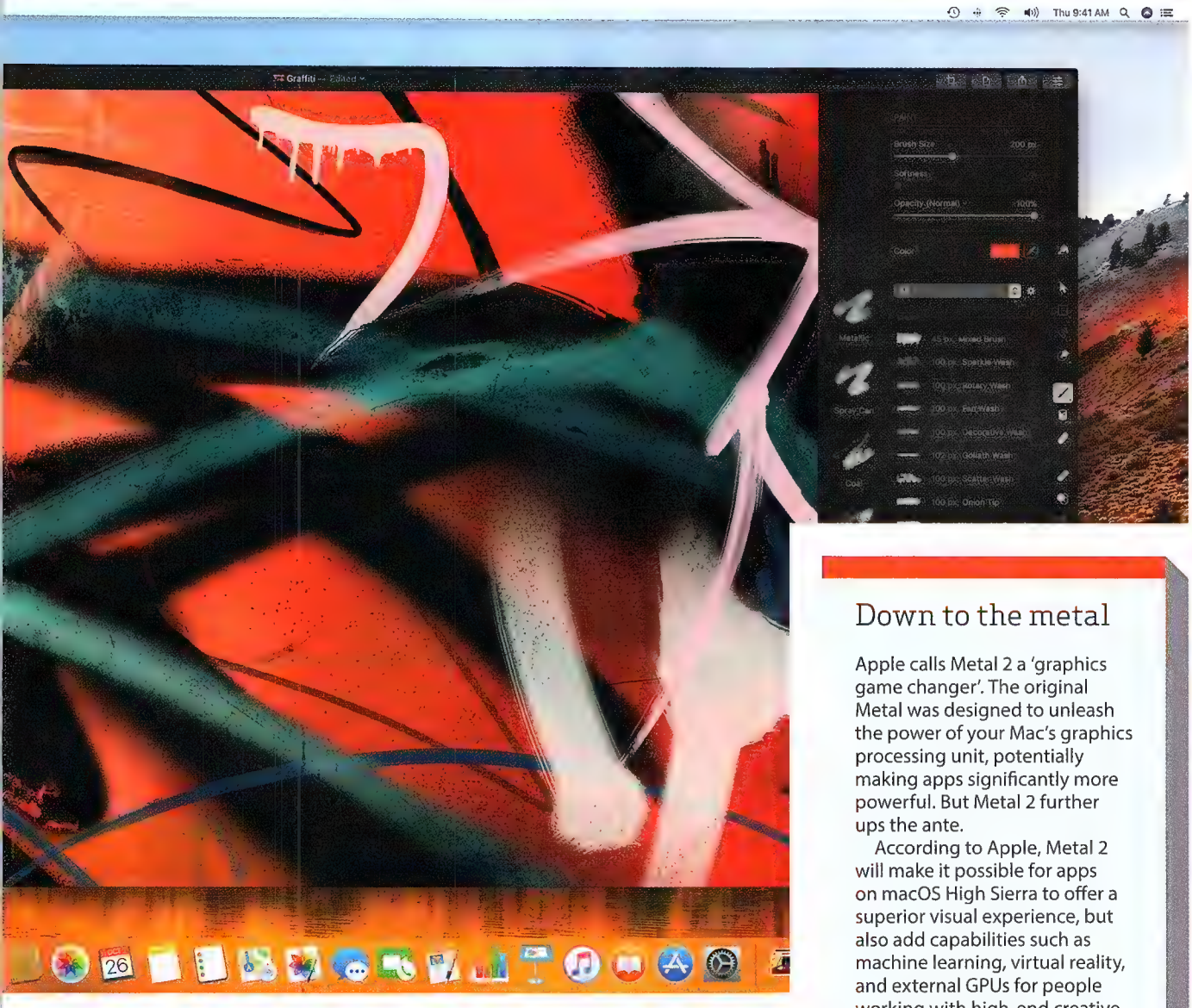
In High Sierra, the Mac follows iOS, tvOS and watchOS devices in transitioning to the Apple File System (APFS). According to Apple, its new file system is designed for flash storage, to be responsive and to be secure. The second point is evident when performing actions like duplicating a bunch of files, or finding the size of folders. Tasks that may have taken some time to complete on an older version of macOS now often happen almost instantly.

That said, you should approach any major change to a file system with caution. At the very least, ensure that you make a fully bootable clone of your Mac (using the likes of SuperDuper! or Carbon Copy Cloner) before upgrading, just in case things go wrong. But you were planning on doing that anyway, right?

Apps like Pixelmator Pro will take digital painting to another level, thanks to Metal 2.



You'll need an umbrella... again. Ask Siri about the weather and she'll confirm it's raining... again.



worlds using the likes of SteamVR and the Vive VR, along with Final Cut Pro, Epic Unreal 4 Editor and Unity Editor. If that feels a bit much like hard work, just sit back in actual reality and let someone else bring lovely new apps to you when they're ready.

COPY AND PASTE

You may be familiar with Universal Clipboard. This feature, which is part of Continuity, works with any Mac that has Bluetooth LE (and also a range of iOS devices). Both Macs need to be signed into the same iCloud account and have Handoff enabled in System Preferences. Then, as long as the Macs are connected to Wi-Fi and have Bluetooth active, you can copy and paste text, images and videos between the two.

In macOS High Sierra, this is taken up another notch, in you being able to copy and paste files. To do so, use 'Command-C' to copy on one Mac and 'Command-V' to paste on the other. This is less hassle than messing about with AirDrop or file sharing. That said, if even this seems a bit like hard work, you can always share your Desktop and Documents folders via iCloud to efficiently move files between Macs.

For a list of devices that are supported by Continuity, visit the following Apple support document: **bit.ly/continuity_support**

64-BIT APPS

If you spend a lot of time using an iPhone or iPad, and you happen to have a large collection of apps and games, chances are iOS 11 thinned your collection somewhat. This was down to Apple ending support for 32-bit apps – something that's long been on the cards. Unfortunately, though, it's simply not viable for every developer to update their apps, and so we've had to say goodbye to thousands of them.

It looks like 'appageddon' is going to come 'back to the Mac' at some point. There were rumours macOS High Sierra would start warning users about 32-bit apps, but that's not happened at the time of writing. Apple did announce at WWDC 2017, though, that all apps and games submitted to the Mac App Store would have to be 64-bit as of January 2018. Updates must be compliant by July.

If you use 32-bit apps, it's time to bug a developer. If you're not sure, go to 'About This Mac' under the Apple menu, click System Report and select Applications from the sidebar. Click the 64-bit column header however many times it takes to get apps marked 'No' at the top, make some notes, and get cracking writing some polite emails.

Down to the metal

Apple calls Metal 2 a 'graphics game changer'. The original Metal was designed to unleash the power of your Mac's graphics processing unit, potentially making apps significantly more powerful. But Metal 2 further ups the ante.

According to Apple, Metal 2 will make it possible for apps on macOS High Sierra to offer a superior visual experience, but also add capabilities such as machine learning, virtual reality, and external GPUs for people working with high-end creative apps.

One app that looks like it'll fully harness this new power is popular image editor Pixelmator. It's set to go 'pro' this spring, with a revamped single-window interface, and a vastly enhanced Metal 2 powered painting engine. See **pixelmator.com/pro** for more information on what looks set to be a cracking new app.

how to

» QUICK TIPS

Experts solve your computing problems

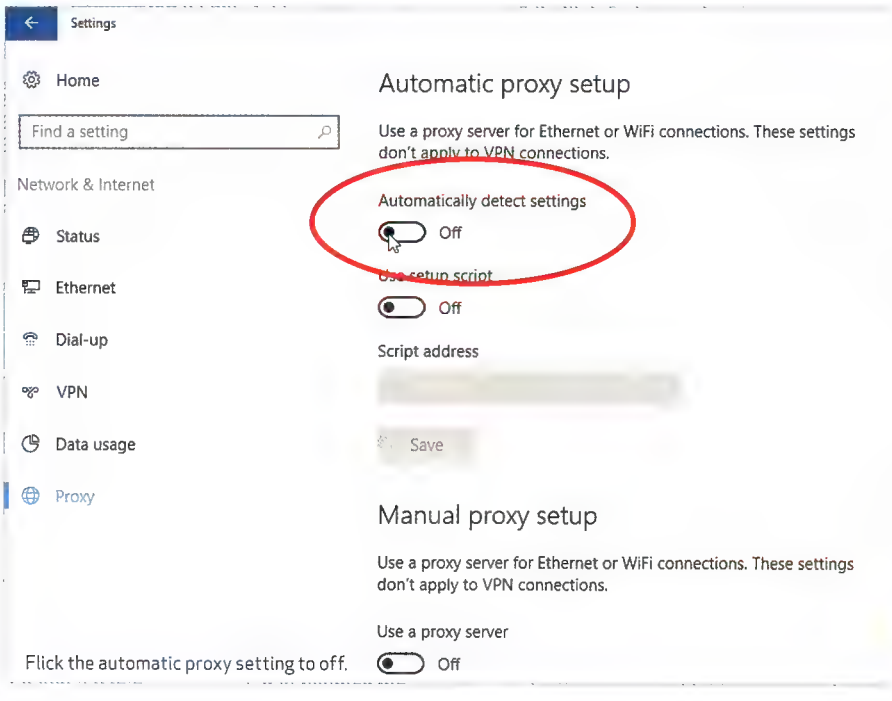
APC and its readers can be one giant helpdesk. If you have a technical problem, chances are one of us can solve it.

SECURITY
HOW DID BITDEFENDER GET ON MY iMAC?

I erroneously opened an email that appeared to be from a friend. In it was a link to a site promoting a weight loss product. A little later, I inadvertently ran an app called Bitdefender that had appeared on my Mac. Is my Mac now infected?
Earl Hill

Bitdefender Free is intended to clear out iffy software, rather than being malware itself, but it's controversial and intended to get you to pay money. If you didn't deliberately install it, we'd remove it, and avoid doing anything that could bring you to install other unwanted apps on your Mac: the next one could be malicious. Mercifully, Bitdefender has its own removal tool, which you should use as soon as you can. If you are looking for tools that are completely free yet invaluable to detect and prevent malware, visit **objective-see.com**, as the tools there are written by one of the leading experts in Mac security. Check your iMac with those and you can be confident that they'll detect any malware you may have acquired.

It's vital that you don't click on links in messages unless you're certain that they are genuine and trustworthy. If you have the slightest doubt, move on to the next message and, when you have a bit more time, return and check out the previous message in more detail. Your Mac is only one click away from disaster. **Ian Sleightholm**



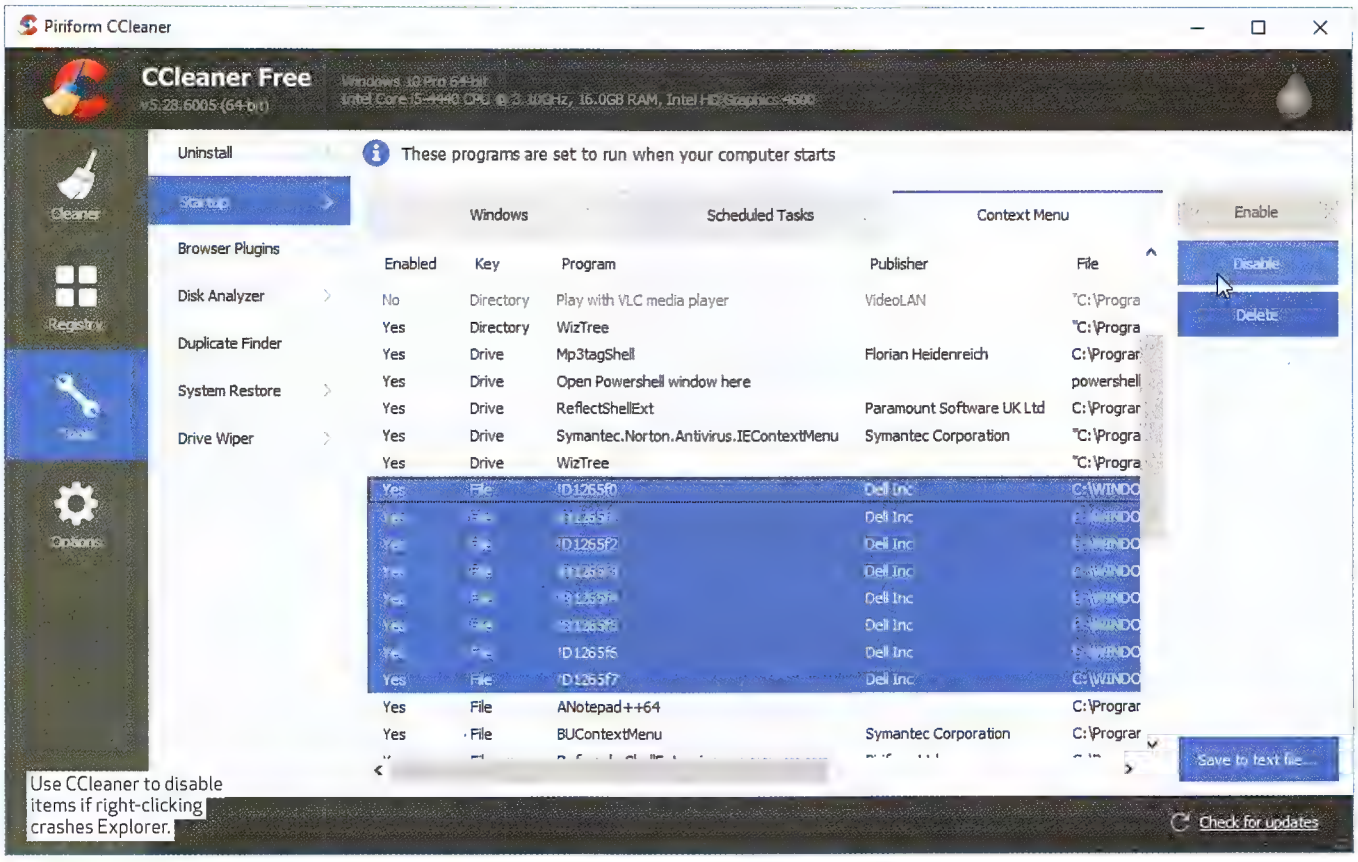
WINDOWS
IS THIS SETTING DANGEROUS?

I've read that WPAD is enabled by default in Windows 10, and that it's dangerous. What is it, and are the warnings correct?
Hunter Travis

WPAD stands for Web Proxy Auto-Discovery, and is a setting related to the configuration of a proxy server. Proxy servers are typically used by organisations – such as companies and schools – to configure a connection to their network, which means, for most people, it's not required. However, past versions of Windows 10 enabled the setting by default, which provides a possible security loophole were you to connect to a public Wi-Fi hotspot that was configured for malicious intent. To cut a long story short, if your PC is only ever connected to a single network at home, the setting isn't dangerous. However, if you're using a laptop or tablet and often connect through public Wi-Fi networks, such as at a café or airport, it's best to disable the setting. To do this, go to 'Start > Settings > Network & Internet > Proxy' and flick the 'Automatically detect settings' switch to Off. You'll now be able to surf safely.
Nick Odantzis

LINUX
INVISIBLE EMAIL SERVER

I need advice on how to structure and set up a simple internal-only email server for my



"To send mail via an external server, use the relayhost parameter, which tells Postfix to go via that server rather than the default."

IoT sensors. I don't want this server visible to the internet. It might be nice if it could send outbound mail via Gmail, but that's not a requirement. The main focus is to keep my data internal. All of the articles I find for setting up simple mail servers have linkages to the WAN, which I don't want; for example, if I install Postfix how do I make sure it works only via my LAN? Do I need Dovecot if I'm not using IMAP or POP? Internally, I use a non-routable domain name for my LAN hosts. My overall architecture for my IoT is to keep it firewalled off from the internet whenever possible. Then only allow very specific, controlled connections when mandatory.
Ron Sparks

What you want is easily achieved with Postfix. The simplest way to make sure it can't be contacted from the internet is to not forward any ports to it in your router, which is the default setup. You can reinforce this in Postfix by adding these lines to:

```
/etc/postfix/main.cf:
  mynetworks_style = subnet
  smtpd_client_restrictions =
permit_mynetworks, reject
```

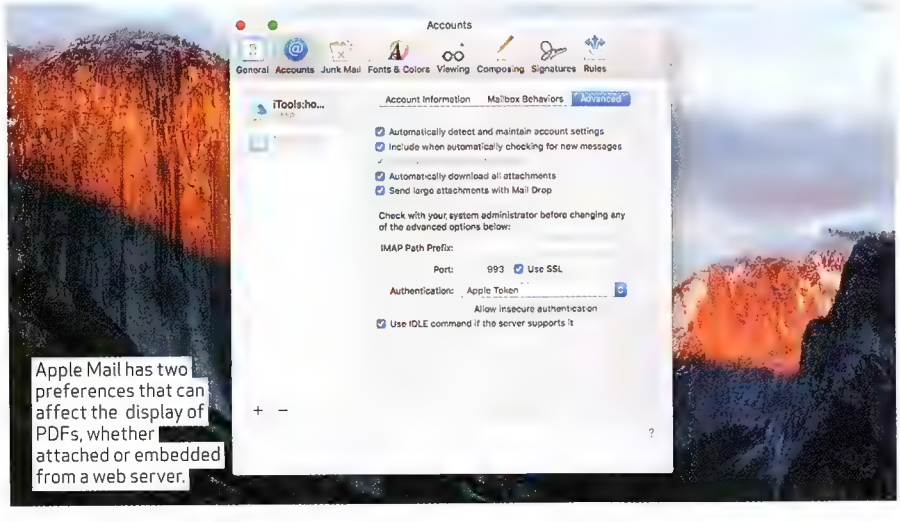
The first line sets your network to be your local subnet, the second tells Postfix to accept connections from your network and reject all others. Instead of `mynetworks_style`, you can specify the network address ranges explicitly with `mynetworks` for more control:

```
  mynetworks = 127.0.0.1,
192.168.1.0/24
```

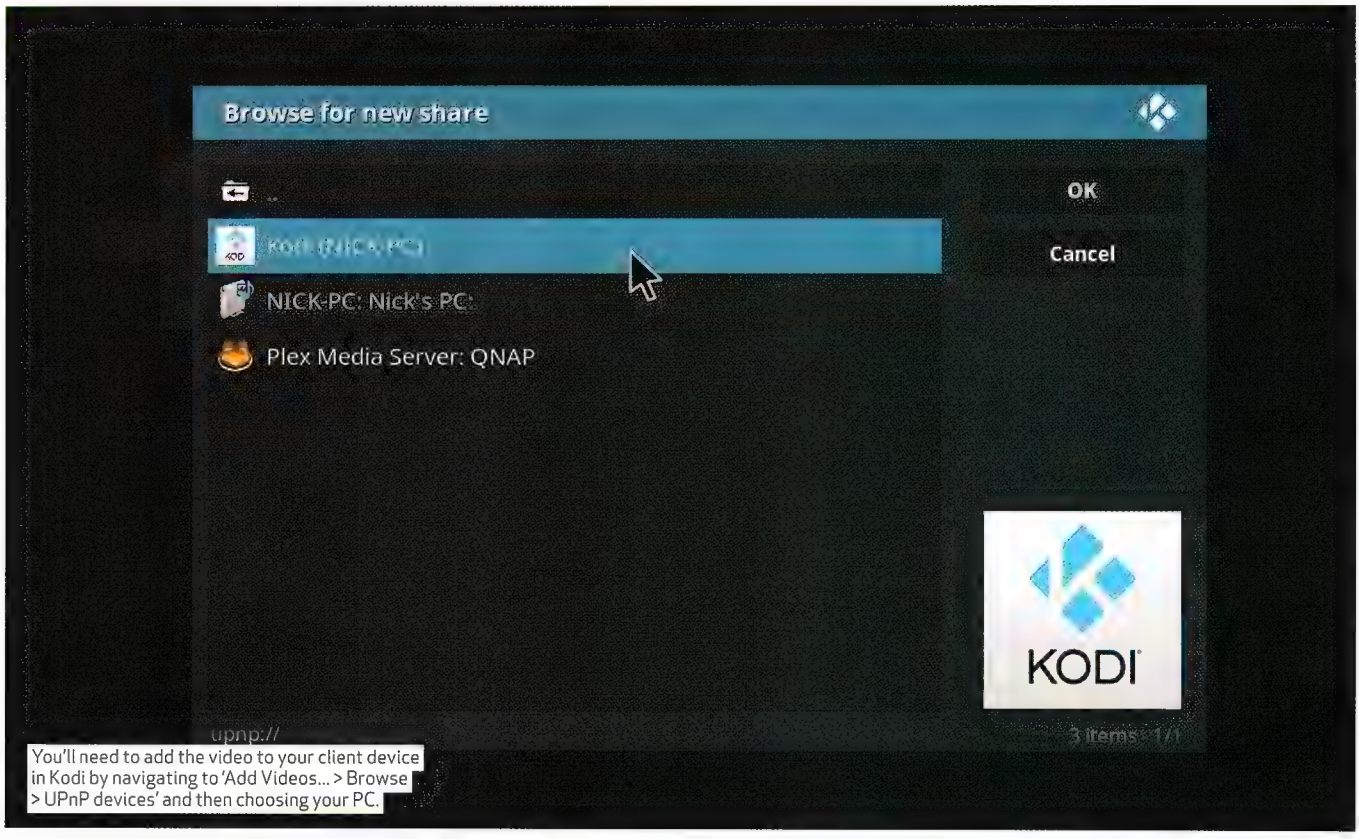
This example restricts it to connections from localhost and anything with a 192.168.1.* address. After changing main.cf, you need to reload or restart the Postfix service.

To send mail via an external server, you use the relayhost parameter, which tells Postfix to go via that server rather than the default. You need more than a simple relayhost setting, as you need to be able to authenticate with the remote server, otherwise your mail will be rejected as spam, so add this to main.cf:

```
  relayhost = [smtp.gmail.
com]:587
  smtp_use_tls = yes
  smtp_sasl_auth_enable = yes
  smtp_sasl_security_options =
```



Apple Mail has two preferences that can affect the display of PDFs, whether attached or embedded from a web server.



You'll need to add the video to your client device in Kodi by navigating to 'Add Videos... > Browse > UPnP devices' and then choosing your PC.

```
  smtp_sasl_password_maps =
hash:/etc/postfix/sasl_passwd
  smtp_tls_CAfile = /etc/ssl/
certs/ca-certificates.crt
```

Now you need to create the password file that Postfix will use to login to Gmail. Create or edit /etc/postfix/sasl_passwd:

```
  [smtp.gmail.com]:587
username@gmail.com:password
```

The square brackets here and in main.cf are needed. Now secure this file and generate the password hash file with:

```
  $ chmod 600 /etc/postfix/
sasl_passwd
  $ postmap /etc/postfix/sasl_
passwd
```

...and restart Postfix. Dovecot is only needed to read mail, Postfix takes care of the delivery.
APC Team

WINDOWS

EXPLORER CRASHES WHEN I RIGHT-CLICK

I have two laptops — one of which is new — and both are running Windows 10. Both have the same problem: when I right-click an item in File Explorer, Windows will momentarily freeze and then File Explorer crashes and restarts. It's not consistent — it occurs around 50% of the time, and it doesn't happen when right-clicking within an application, just File Explorer. Any ideas?
Peter Hoarea

This is usually linked to a third-party program adding an option to the context menu that appears when you right-click a file, folder or drive.

We told Peter to use CCleaner (**www.piriform.com**) to view what items were currently present in the context menu by heading to 'Tools > Startup > Context Menu'. Here, you'll see a list of entries linked to directories (folders), drives and files – and one or more of these will be causing the crash.

Start by selecting them all, then click Disable (some entries may be blocked, ignore these). You should find the right-click menu works correctly, enabling you to start re-enabling items until you encounter the crash.

Peter used this technique to trace the problem to the entries related to Dropbox – as he didn't need the extra features, simply leaving these disabled fixed his problem.
Alex Cox

MAC

BROKEN PDF ATTACHMENTS IN APPLE MAIL

I normally check my mail first on my iPhone, where I haven't experienced problems viewing PDF attachments. However, when I read the same messages on my MacBook Pro, I often get errors that its attachments are missing, or may be damaged and unreadable. What's causing this?
Nick Cook

This might result from the settings in the copy of Mail on your MacBook Pro. Open its preferences, select the Accounts tab, and then for each of your accounts, go to the Advanced tab. Ensure there's a check mark next to 'Automatically download all attachments'. Next, go to the Viewing tab, and ensure 'Load remote content in messages' is also checked. These should guarantee all PDF attachments are properly downloaded to your Mac. If the issue persists despite those settings being correct, try to rebuild any affected mailbox(es) affected.

Select one on the left and choose 'Mailbox > Rebuild', then repeat for additional problematic mailboxes. If you still can't reliably access PDFs sent to you, the best workaround is to try saving them and then opening the saved files. A few people seem to suffer from this as a more persistent problem, though the majority don't.
Ian Sleightholm

MEDIA

SHARE YOUR KODI MEDIA LIBRARIES

I enjoyed your Kodi tutorial from issue 443 (page 88), but I'd like to be able to share my media directly from Kodi without having to use another program such as Plex. What must I do?
Gerry Bukowski

Good as it is, Kodi simply doesn't provide as slick a user experience as Plex or Emby, but its DLNA-compatible server

is widely accessible from a range of other devices. Here's how you set it up.

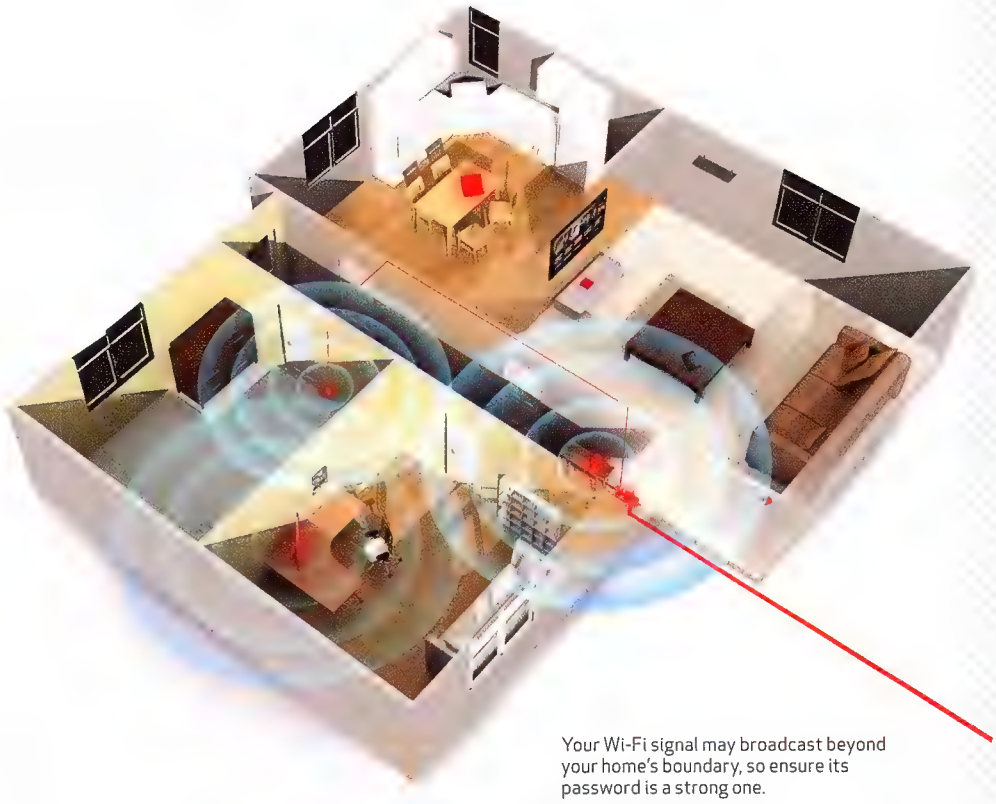
Open Kodi and click the Settings button followed by Service Settings. Select UPnP/DLNA in the left navigation pane, then flick the 'Share my libraries' switch to On to share your media. Kodi should show up as a DLNA/UPNP source on compatible devices.

You can access your shared media libraries from another computer, iPhone or Android device by installing Kodi on there. Once done, navigate to 'Service Settings > UPnP/DLNA' on there and flick the 'Allow remote control via UPnP' to gain access.

Next, you need to physically add the shared content to your client device – from the home page, select your target library and enter the files section. Click 'Add videos...' followed by Browse, UPnP devices and select your PC. Click OK twice.

You can now access your shared media libraries – they won't show up on the main screen, instead, select Movies and click 'Enter files section' to manually browse your libraries using the same navigation tools as found in Kodi itself.

APC Team



Your Wi-Fi signal may broadcast beyond your home's boundary, so ensure its password is a strong one.

INTERNET
GETTING THE BEST WI-FI CONNECTION

We use a couple of Wi-Fi access points to deliver good signal coverage throughout our house and garden. How should we configure them to ensure our devices always get the best wireless connections?

Rachel Stelmach

In theory, you should set up each with a unique name and password, so that, in the event of problems, they are easier to identify. However, some devices don't simply connect according to the best signal, but first and foremost according to the priority list of access points, and so may well opt for a weaker signal if that connection happens to be at the top of the list. You can use this to your advantage by giving your access points identical names and passwords. They'll still have unique IP addresses, and will automatically configure themselves to operate on different wireless channels.

When your device then tries to connect, it'll give both the access points equal priority, and should choose the one with the better signal. This should in turn ensure you get the fastest speed and a more reliable connection. If you then have a wireless problem and need to work out which access point is causing the problems, you'll have to rename it until that's fixed. One other important matter is that you must ensure the common password is long, impossible to guess, and robust. Unless you're in a remote location, it's wise to turn off guest access to reduce the risk of anyone breaking into your network.

Ian Sleightholm

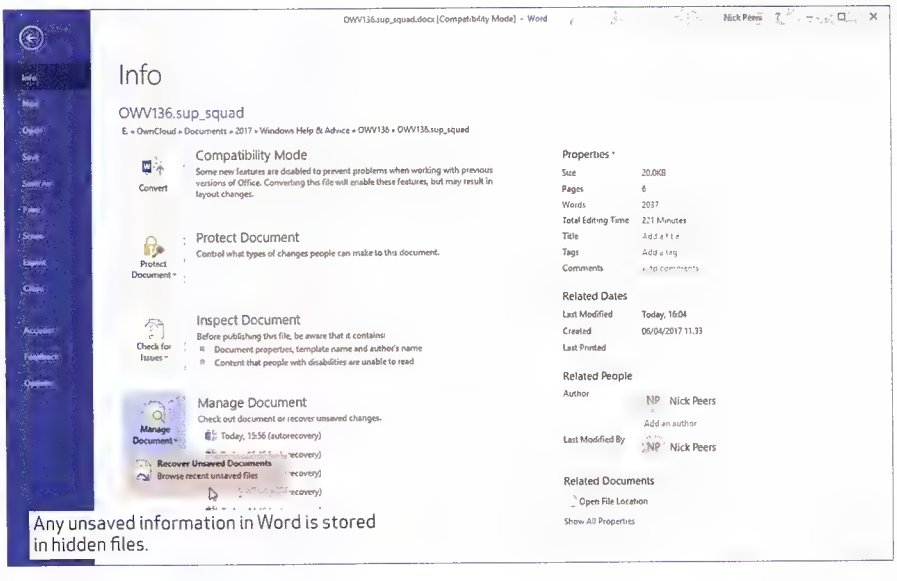
MICROSOFT OFFICE
ADVANCED DOCUMENT RECOVERY

Wouldn't you know it? Word has just crashed and, when I reopened it, it told me it can't open an ASD file because it's already open in Word. As a result, I end up with a read-only copy of the file I was working on, with none of the changes I'd made in the previous half hour. Can you help?

Louise Taylor

Most, if not all, of your unsaved changes. First, let's back up that file – just in case. Press 'Win-R', type %appdata%\Microsoft\Word and hit Enter. You should see the file in question – an AutoRecovery save of <filename>.asd. Ordinarily when you reopen Word the AutoRecover dialogue should appear with this file, so you you can restore your changes. For now, copy – don't move – this file to a convenient location, such as your Documents folder. Now reopen Word to the File screen. Click the Manage Document button and choose Recover Unsaved Documents. You'll be dumped inside a different folder – C:\Users\nickd\AppData\Local\Microsoft\Office\UnsavedFiles. If a duplicate of the ASD file isn't here, navigate to where you copied it, select the file and click Open. The file will open in a separate window – verify it's the version you want, then click the 'Save as' button at the top to save a copy.

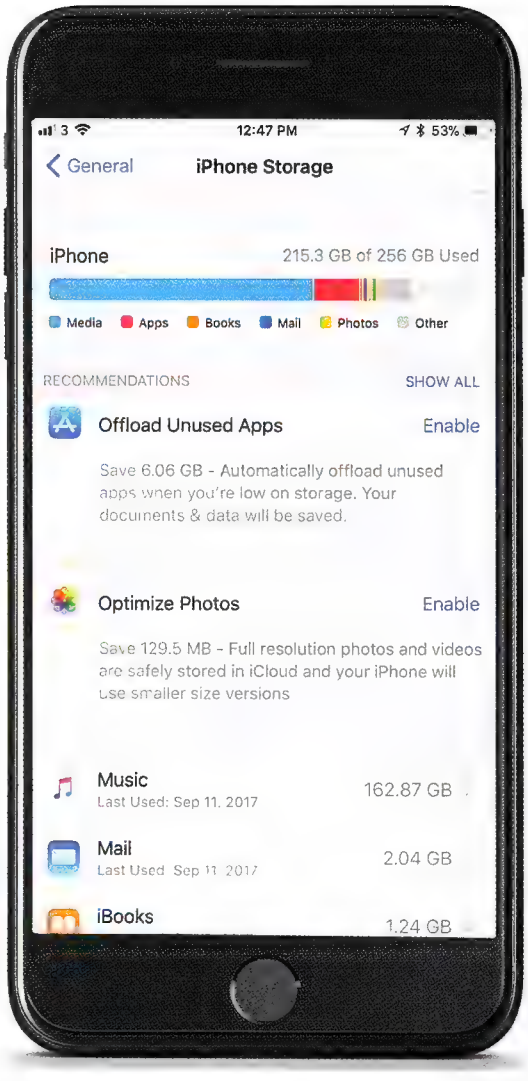
Alex Cox



Any unsaved information in Word is stored in hidden files.

Manage iPhone and iPad storage in iOS 11

Alan Stonebridge shows how to use iOS 11's improved automatic and manual storage management.



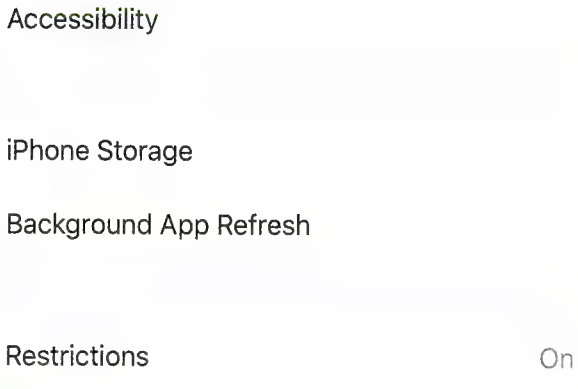
Apple's new OS – iOS 11 – includes a storage management improvement that offloads unused apps, and there are two ways to use it. Offloading an app removes it from your device, but leaves behind data associated with it. If you want to use that app again in future, you just tap its icon on the Home screen to reinstall it and carry on as normal. Meanwhile, you have space for whatever task is at hand.

The most convenient way to use this capability is to allow iOS to automatically work out which apps to offload, based on analysis of your past usage. By leaving it to iOS to decide what gets offloaded, you run the risk of finding an app you need is no longer installed when your internet connection is infeasibly slow or unavailable to redownload it. So you also have the option of manually offloading apps.

Either way, this feature should make dealing with dwindling free space much less hassle than it used to be.

How to

Manage your storage



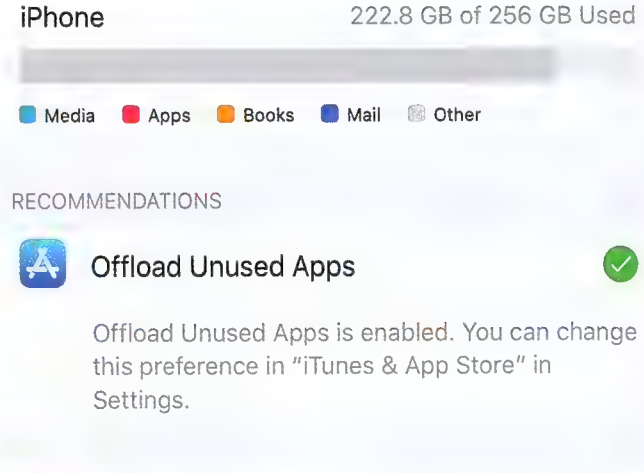
1 FIND THE RIGHT SETTINGS

Go to 'Settings > General' and tap either 'iPhone Storage' or 'iPad Storage' a little way down the page. Give the next page a while to populate; depending on your device's capacity and contents, it can take a while to complete.

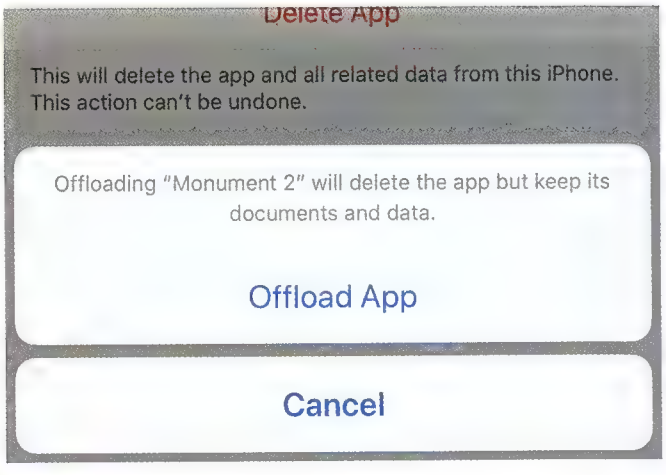
2 AN OVERVIEW OF USAGE

At the top, you'll see a colour-coded chart that provides an at-a-glance summary of the types of things that are taking up space, such as apps and media. This helps you work out where you might save space.

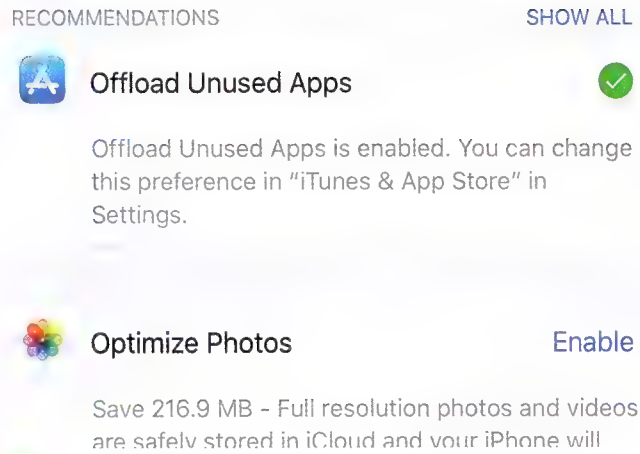
3 RECOMMENDATIONS
Before you dive in to delete anything, check whether there's a Recommendations section just below the chart. What appears there, if anything, depends on your current choices elsewhere in Settings.



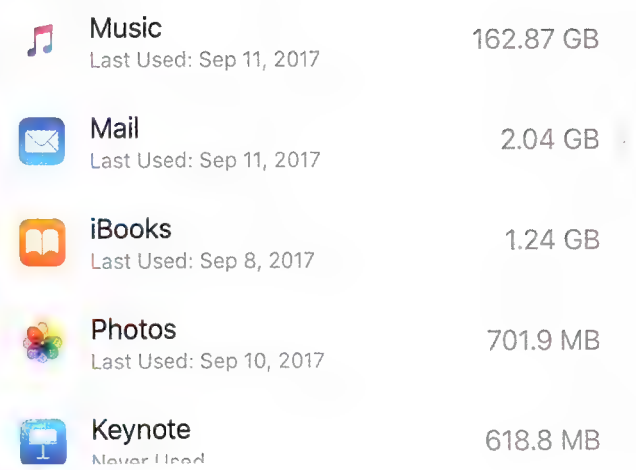
5 OFFLOAD UNUSED APPS
This recommendation shows how much space you'll save by accepting it. If your device later needs room to do something, it'll remove apps you're unlikely to use to accommodate it, but retain their data on your device.



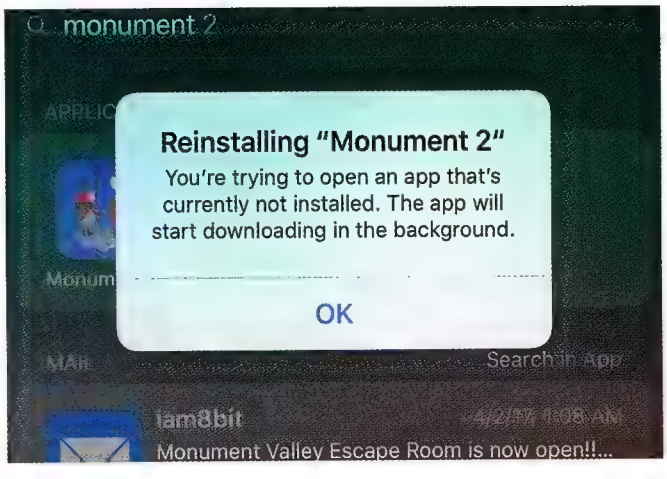
7 OFFLOAD A SINGLE APP
Tap an app in the list and its summary gives you a choice of offloading it, to free up the amount listed next to App Size, or deleting all traces of the app and its data from your device — see the tip to the right, though.



4 ACCEPT A CHANGE
A short description is given of what each item will change about your device's behaviour. You may want to look up additional details at **support.apple.com**. Tap Enable at the top right of a suggestion to act on it.



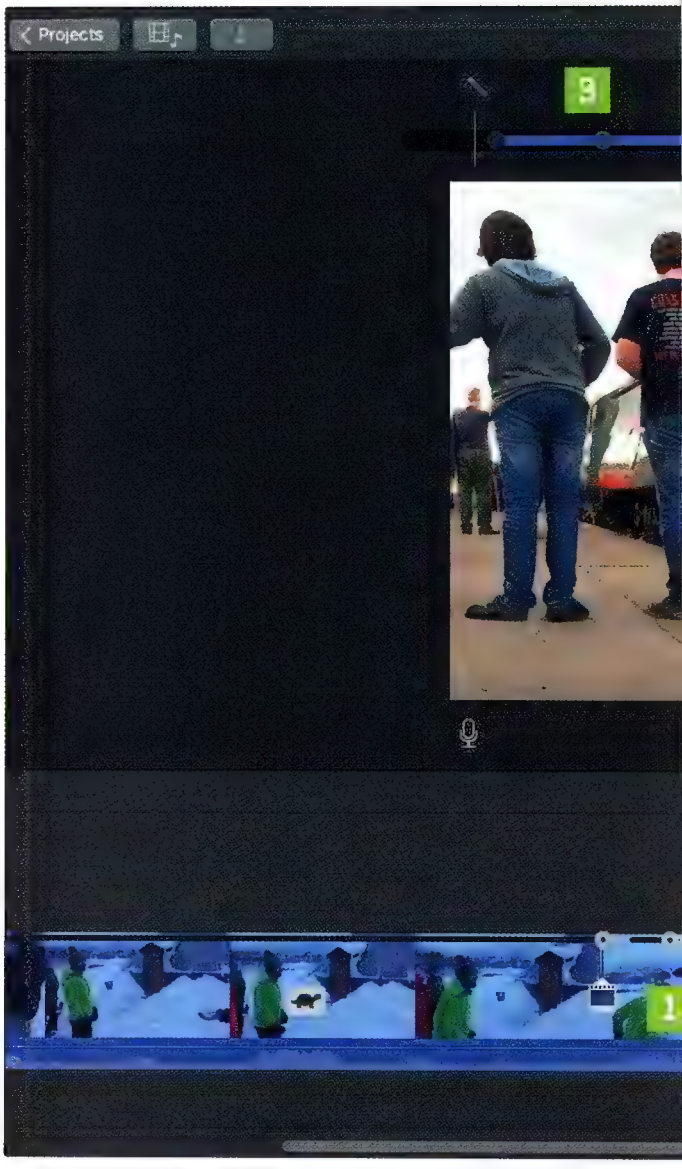
6 MANUALLY MANAGE APPS
You needn't entrust iOS with decisions about which apps are offloaded; lower down the page, each installed app is listed with the space it and its data collectively take up, and — new in iOS 11 — the date you last used it



8 RESTORING AN APP
When an app is offloaded, its icon stays on the Home screen and shows up in search results. You can tap it in these places, or tap 'Reinstall App' in its storage management summary, to redownload and continue using it.

Master advanced colour editing in Apple iMovie

iMovie might look like an app for beginners but Dave Stevenson knows of some pro-level tools lurking underneath the surface.



We love iMovie. At its heart, it's a fantastically easy-to-use video editor: simply drag and drop your clips into the timeline, move them around, hit share and voilà! Other common jobs, such as adding soundtracks and sound effects, are equally straightforward.

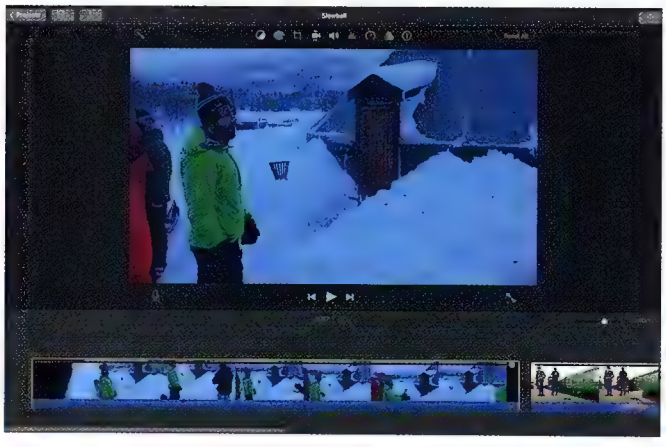
But beneath iMovie's simple-looking interface beats the heart of a powerful video editor that can be used to make projects far beyond the scope of its pre-built themes you were so impressed with when you first used it.

There are plenty of things you can do to get your iMovie projects looking professional – many of which involve knowing how best to use the camera you use to shoot. But understanding how to render colour correctly is one of the most important starting points, and iMovie has some powerful tricks up its sleeve in that regard. Here's how to get the most from its hidden tools.

Get perfect colours with iMovie

1 CHOOSE YOUR CLIP

This clip, shot in the snowy Arctic, is a classic of its type — video cameras of all types are likely to get things wrong when faced with a barrage of snow and overcast skies. We're sure you've got plenty just like it — over at Perisher perhaps.



2 DIAGNOSE THE PROBLEM

iPhone video typically doesn't need much in the way of saturation boosts, with video from the camera normally looking pretty punchy. Here, we've got a white balance that's miles off — hence the blue hue — and a fairly dramatic underexposure.

1 YELLOW BOX
When working with multiple tracks, the yellow box shows which you're altering. Use 'Shift-click' to select and adjust multiple clips at once.

2 REAL-TIME EDITS
iMovie is powerful: the changes you make are reflected in your clip in real time, making it easy to keep track of what you're doing.

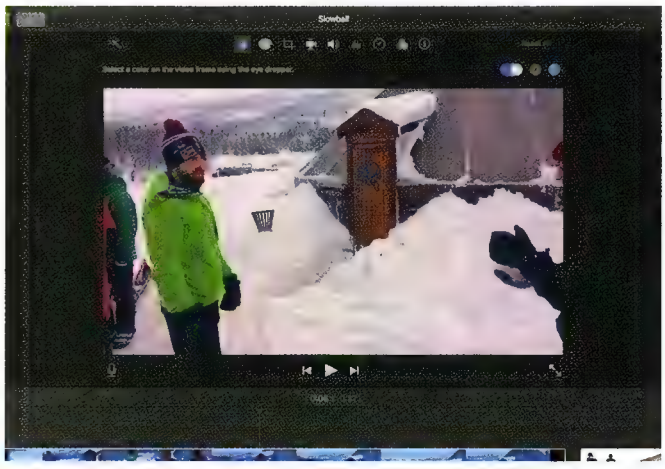
3 MAKE ADJUSTMENTS
These sliders — respectively — are for adjusting the white and black point of the clip, its saturation and its hue. But the controls above allow you to change far more.

4 UNDO MISTAKES
Made a mistake? iMovie makes it easy to revert to your original footage with this super handy 'get out of jail' button.

5 FILTER WOES
iMovie's built-in filters are about as subtle as a pair of Dame Edna's glasses, so steer clear, experiment and learn how to grade footage all by yourself.

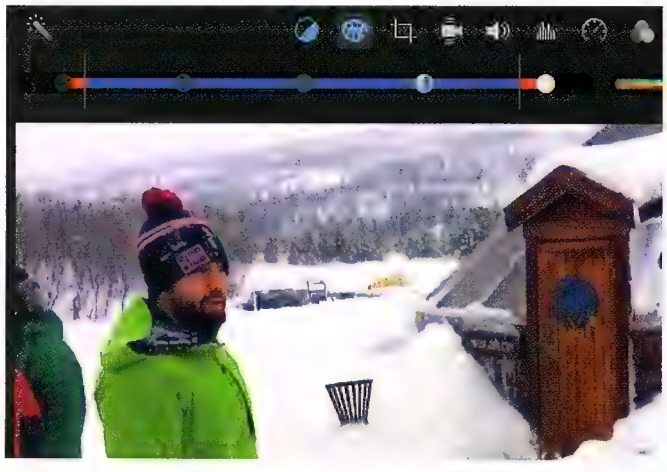
3 SELECT YOUR CLIP
Choose the clip you want (look for the yellow box that appears when one is selected), then head to the row of editing options directly above it. These control how your clip looks in almost every respect.

4 OPEN THE IMAGE CONTROLS
It's always worth attempting the easy way to start with. Click the (leftmost) Color Balance tool, then choose White Balance from the dropdown. Click anywhere in the frame that should be either white or grey and...



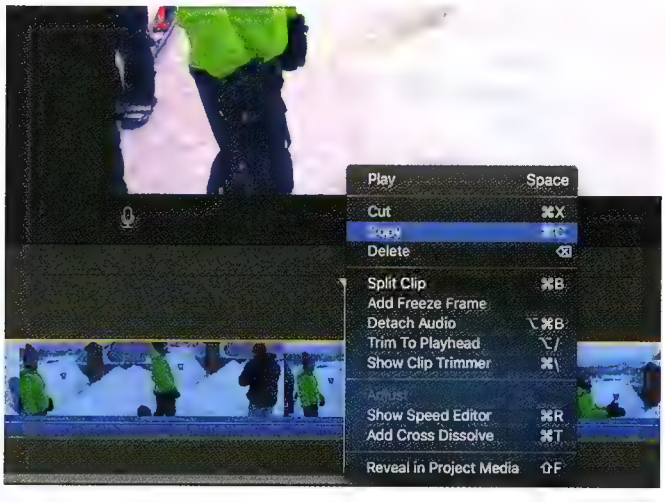
5 WHITE BALANCE

...Presto! The colours instantly lift to the right point. Try this first with virtually any dodgy-looking winter clip and a decent result should be obtainable almost instantly. Hit the tick to confirm your changes.



7 CONTRAST

This slider is a bit tricky to master. The extreme ends adjust a clip's levels: where the black and white points are, so dragging them away from each other increases apparent contrast. Experiment until it looks right to you.

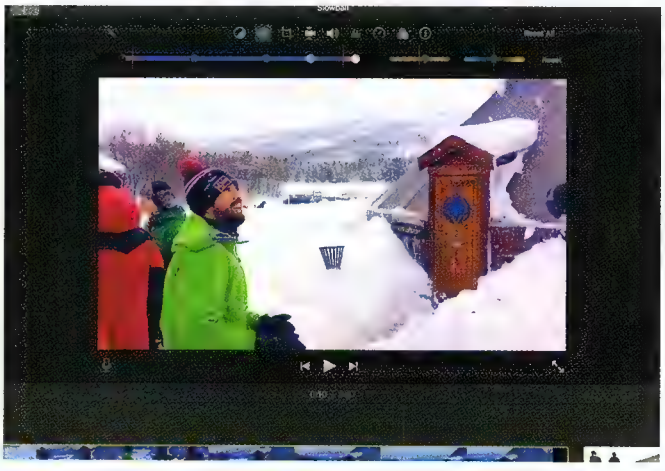


9 COPY

Bigger projects, of course, will have multiple individual clips, and if they were all shot in the same lighting conditions, the changes you've made to your first clip will be appropriate for other clips. To copy your settings, right-click and choose Copy.

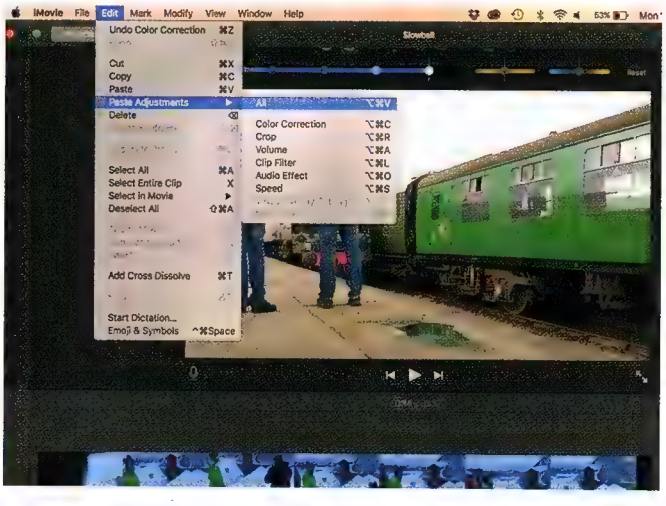
6 FIXING COLOURS

How your footage looks straight off the camera depends what you shot it on. An expensive camera doesn't necessarily get it right every time. DSLRs, for example, often shoot quite flat footage, so hit the Color Correction button next.



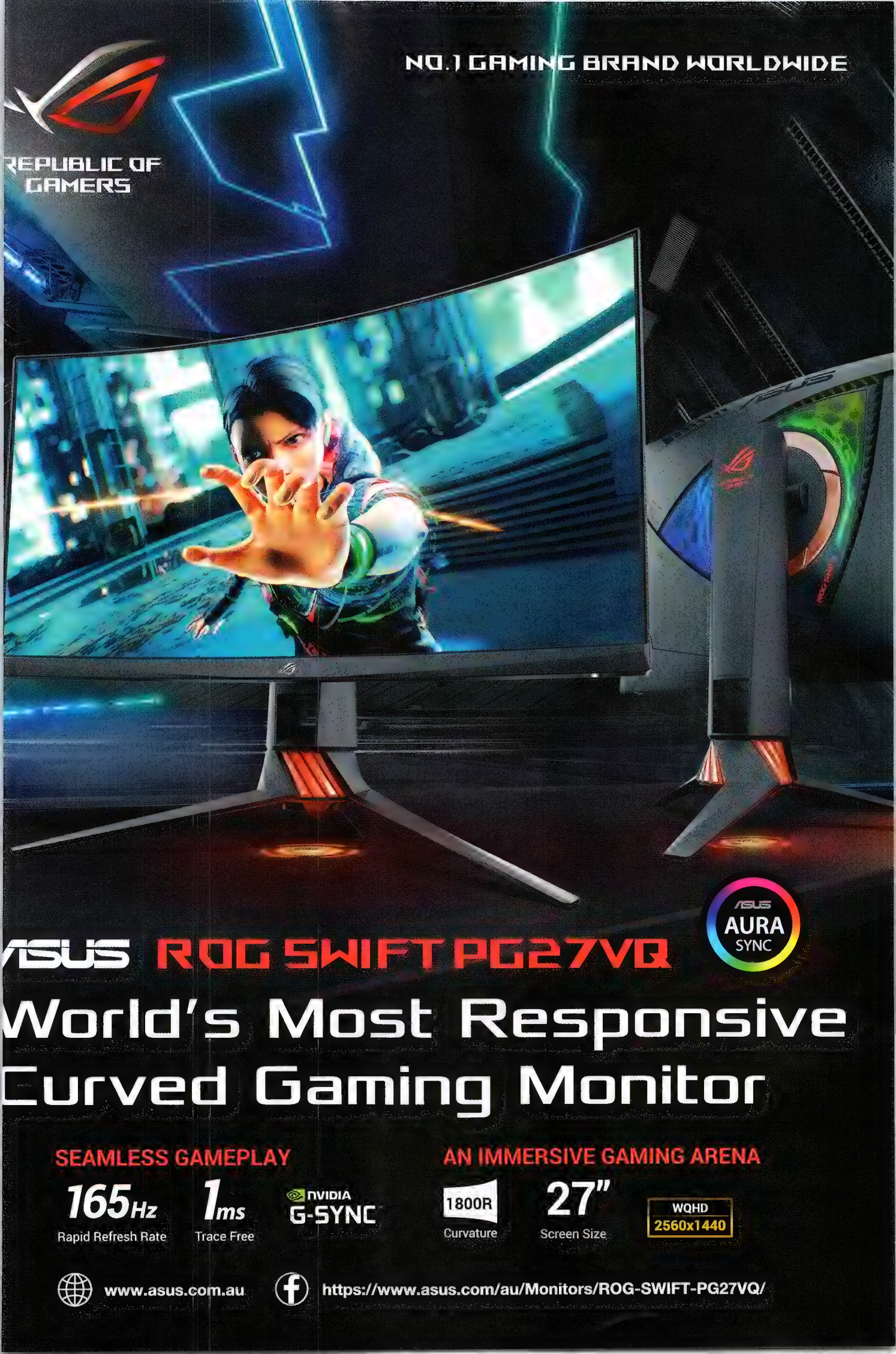
8 AND BRIGHTNESS

The handle in the middle adjusts brightness — normally dragging it slightly right will get your clip looking spot on; while the teeniest of tugs on the saturation slider to the right should finish most jobs. Apply a light touch!



10 AND PASTE

Choose another clip, and click 'Edit > Paste Adjustments'. If you've followed the steps above, Video is the one you want to choose, but you'll notice there are plenty of options besides — as well as being able to copy all your adjustments at once.


NO.1 GAMING BRAND WORLDWIDE
REPUBLIC OF GAMERS
ASUS AURA SYNC
ASUS ROG SWIFT PG27VQ
World's Most Responsive Curved Gaming Monitor
SEAMLESS GAMEPLAY
165Hz Rapid Refresh Rate
1ms Trace Free
NVIDIA G-SYNC
AN IMMERSIVE GAMING ARENA
1800R Curvature
27" Screen Size
WQHD 2560x1440
www.asus.com.au
https://www.asus.com/au/Monitors/ROG-SWIFT-PG27VQ/

Edit photos in Linux with digiKam

There's nothing quite like digiKam for all-round photo mastery. Adam Oxford gets you started with this comprehensive tool.

Gnome's default photography tools are a disaster. The ageing Shotwell is OK, but inclined to hang if you ask it to deal with more than a couple of year's archives, and the new Photos has a mind of its own when it comes to building a navigable archive. Gnome users who are serious about their photography can draw upon a hotchpotch of decent tools, but nothing comes close to the joy that's expressed by their KDE-preferring peers who use digiKam.

digiKam is unique not just in the Linux world, but pretty much in all of computing for its comprehensive approach to photo management. Some software is good at RAW (raw) conversion, some is good for building a navigable library of thumbnails. Only digiKam has it all, from lightbox to facial recognition and even a 'fuzzy search' tool for looking up similar photos to the one you're looking at now.

It's phenomenal, and it's also — at first glance — a touch intimidating. Here's how to get started.

DOWNLOAD THE UPDATE

At the time of writing, the latest version of digiKam is 5.6.0. It's a recent update, though, so your repository is probably stuck at 5.5.0. There are a couple of features in the newer code that you'll want, specifically the ability to build HTML galleries and upload them directly from digiKam and to edit together photo slideshows. In Kubuntu, you can install the update by going to Konsole and entering:

```
sudo add-apt-repository ppa:philip5/extra
sudo apt update
sudo apt install digikam
```

The first time you run digiKam, it'll take you through a set-up wizard. For the most part, you won't want to change any of the default options, but you will want to tell digiKam where you keep your images. This could be in /home/user/Pictures, or it could be in a separate drive with an archive built up over the years.

digiKam will also need to build a few database files, which can be saved in the default location or somewhere else. If you do want to move it, make sure it's not on a removable or networked drive.

On its first run, digiKam will begin thumbnailing and sorting all the images in the location you set.

FINDING YOUR WAY AROUND

For the most part, digiKam is straightforward to navigate. On the left-hand side of the screen, there's a vertical icon menu that selects how you want to search for images. These are based on the metadata of the images in your library. On the right, there's another vertical menu that enables you to manipulate the currently selected of image or images.

When you select an option from the left or right, it'll open a pane on that side of the main digiKam window that can be hidden by clicking again. The top set of icons controls what you see in the main pane, or open up separate windows for the Light Table and Image Editor.

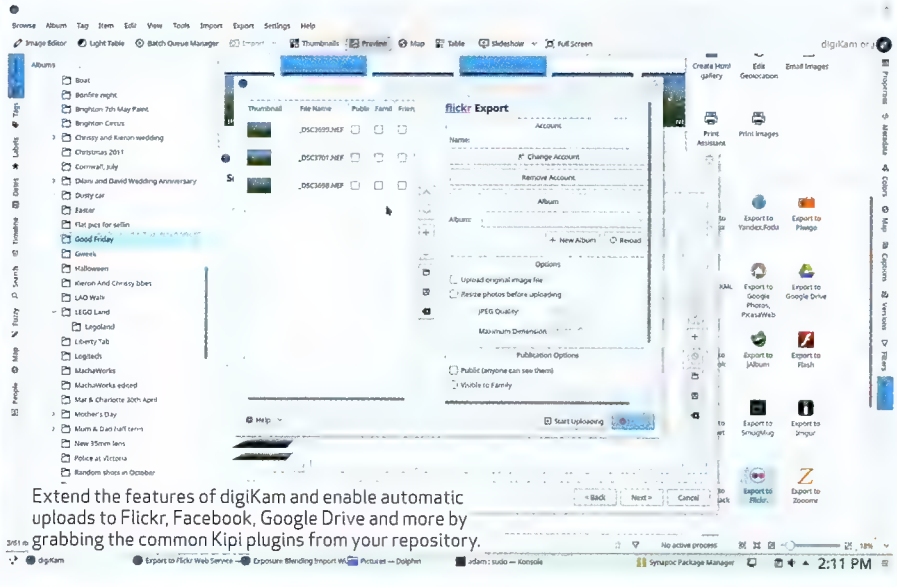
The interface has a few odd quirks you'll need to be wary of. For example, there are three buttons called Map, one on the right, one on the top and one on the left. The left is to search for images with geolocation tags in their metadata; the one on the right is to edit the metadata of the currently selected image. The top one should be similar to the one on the left, but operates in the main pane, but, in our testing, is pretty buggy. There's also some repetition: the Tools button on the right is almost, but not quite, identical to the Tools menu in the top bar.

As well as maps, there are other fun features you can play around with at your leisure. There's an experimental feature for automatically recognising faces in your archive, and a 'Fuzzy' search with which you can draw a very rough outline of what a photo looks like in your memory, and test digiKam's ability to find it from your doodle. More usefully, Fuzzy search can be used to find images similar to, or duplicates of, the one you're currently looking at.

In order to use the Fuzzy search function, digiKam will need to fingerprint all the images in your library, which can take a long time if you have a lot of shots.

Realistically, however, of all the navigation functions on the left the ones you're most likely to use are Albums, Labels, Tags and Dates. Labels, Tags and Dates are based on metadata captured from the images themselves, and Timeline is effectively the same as Dates, but uses a graph instead of a folder tree to sort images by date captured.

The Albums view is a blend of a file browser and a virtual album library.



Extend the features of digiKam and enable automatic uploads to Flickr, Facebook, Google Drive and more by grabbing the common Kipi plugins from your repository.

HDR and panoramic images

You can stitch multiple photos together to make a panorama or high dynamic range (HDR) image without leaving digiKam. You will, however, need to install the Hugin plugin first. KDE will direct you to the Hugin website (**www.hugin.sourceforge.net**) to do this, but chances are that you can grab it from your distro repository using `sudo apt install hugin` or equivalent.

To create an HDR image, you'll need access to a bracketed photograph. This just means that three identical images have been taken at different exposures: the one in the middle is the right exposure and the others are under- and over-exposed brackets. Most modern cameras have a setting that will enable you to do this automatically.

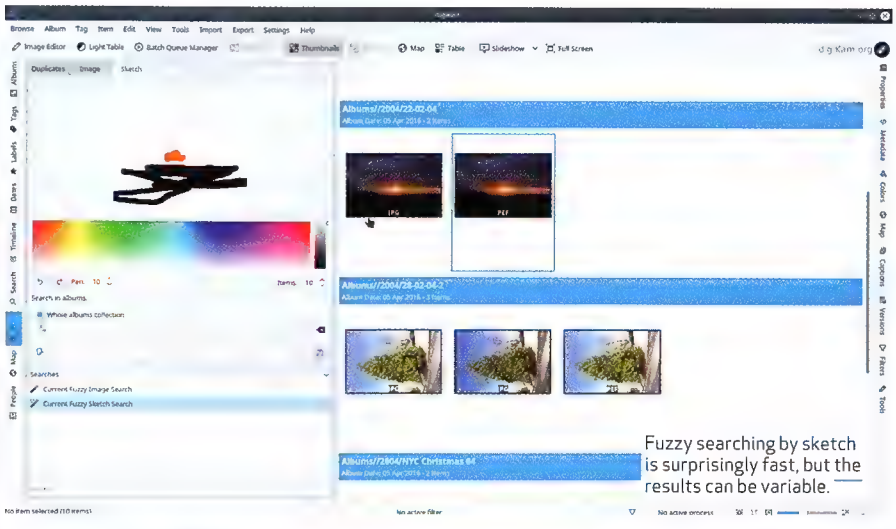
In digiKam, you can combine these three images into one HDR image using the Create Stacked Images option from the Tools menu. Select your brackets images, click the option and then just click through the options without changing anything: digiKam will do the rest.

The Create Panorama option will do the same thing and align up multiple images shot in a row.

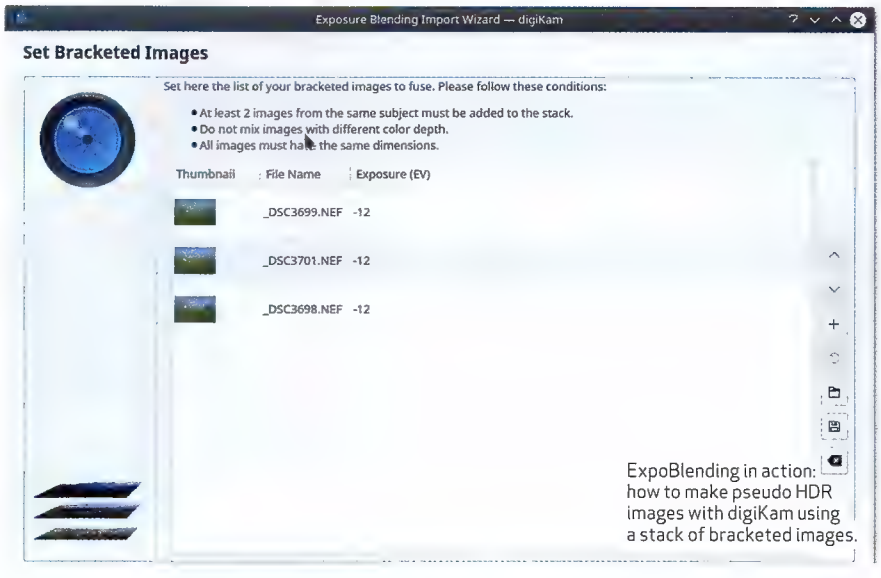
There are two ways to get images into digiKam. If you have a large library of images already on your hard drive sorted into meaningful folders (such as Year/Date/Location), the easiest way to import them is to add your Pictures folder as an Album. This can be done either in the set-up wizard or by going to 'Import > Add folder' and then selecting 'Pictures > New album > Pictures'.

Now, whenever you add a new folder to your Pictures folder on your hard drive, by copying it over from your camera for example, digiKam will update its library.

If you want to use digiKam to import images directly from a camera or SD card, just connect them to your PC via USB (or a built-in card reader) and use the Import menu to pull the photos over. DigiKam doesn't use virtual albums, so if you tell it to import pictures to an album it'll make copies in that physical location. That's fine if you're importing from a camera, but could see you fill a hard drive with duplicates if you already have the pics on your PC already.



Fuzzy searching by sketch is surprisingly fast, but the results can be variable.



ExpoBlending in action: how to make pseudo HDR images with digiKam using a stack of bracketed images.

WORKING WITH YOUR PHOTOS

Once you've got to grips with importing and sorting images, the main image pane should start to make more sense. Call up a file location, date, search or tag in the navigator and all the images linked to that will appear as a thumbnail grid in the centre pane.

Using the top icons, you can also view this list in a row-by-row format by clicking 'Table' or on a map, but realistically, the two views you'll use most are Thumbnails and Preview. Preview shows the currently selected image with the rest of the folder as a film strip at the top, while Thumbnail is a grid of images. You can change between the two views quickly by clicking the selected image.

By default, there's a lot of information in the Thumbnail view. Each thumbnail includes the image name, rating, tags, format, caption, description and label below it, as well as some basic editing tools for rotating the view above. Unless you're an aspiring archivist, it's unlikely that you'll use all of these all of the time.

Typically, you might reference an image by filename, label and tags, for example. Without adding the rest of the information to all the images, it's going to leave a lot of blank space reserved for that information. You can tighten up this view by going to 'Settings > Configure digiKam'. Under the Views tag, you can customise the information that appears underneath each image. You'll most likely want to restrict this to the filename, rating and label. Now select Tooltips. In the Icon Items tab, you can make all of the other information about the picture that you might want appear when you mouse over a thumbnail.

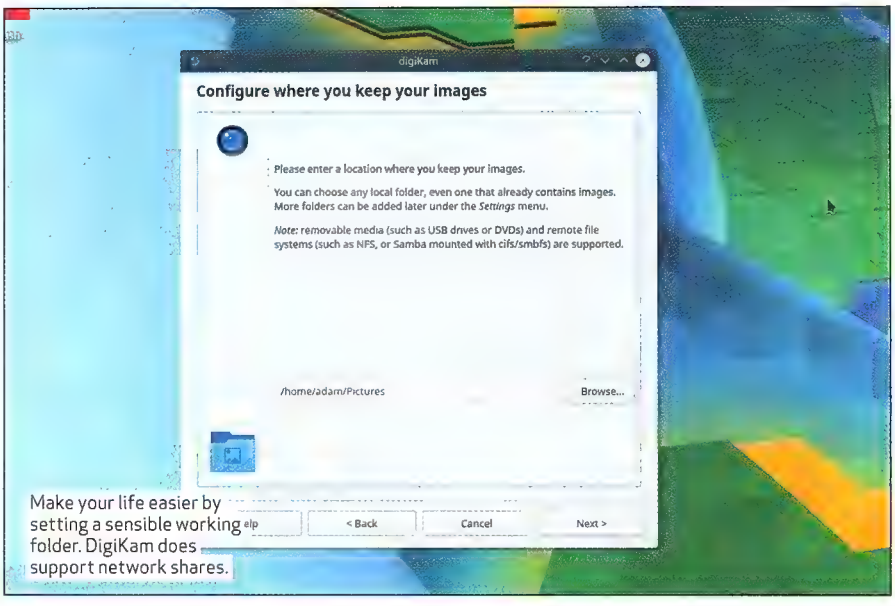
SORTING YOUR COLLECTION

DigiKam will enable you to edit any part of the metadata stored as part of an image, right down to the type of camera used to take the shot, and the lens settings. Select an image and go to 'Item > Edit Metadata'. This is more useful if you want to scrub metadata from a shot for privacy reasons than if you want to fool your friends into thinking you own a $10,000 camera by changing the EXIF information. From the same Item menu, you can also (more usefully) add geolocation data if it's not been written in by your camera.

You can also view the metadata for a particular image using the Properties and Metadata menus on the right, but these won't enable you to make any changes to an image.

The three main types of metadata that you will want to edit, however, are Tags, Ratings and Labels. Each has a key role to play when building up a workflow for processing pics.

Tagging photos is time consuming, but useful when you're searching a large archive at a later date. You can apply tags either by right-clicking a thumbnail or selection of thumbnails, or by using the Filter or Captions menus on the side. Each of these has a list of current tags which you can drag and drop onto images or groups of images. Both of the Tools menus contain a link to open the more powerful Tags manager, which is great for creating and editing tags in batches.



Make your life easier by setting a sensible working folder. DigiKam does support network shares.

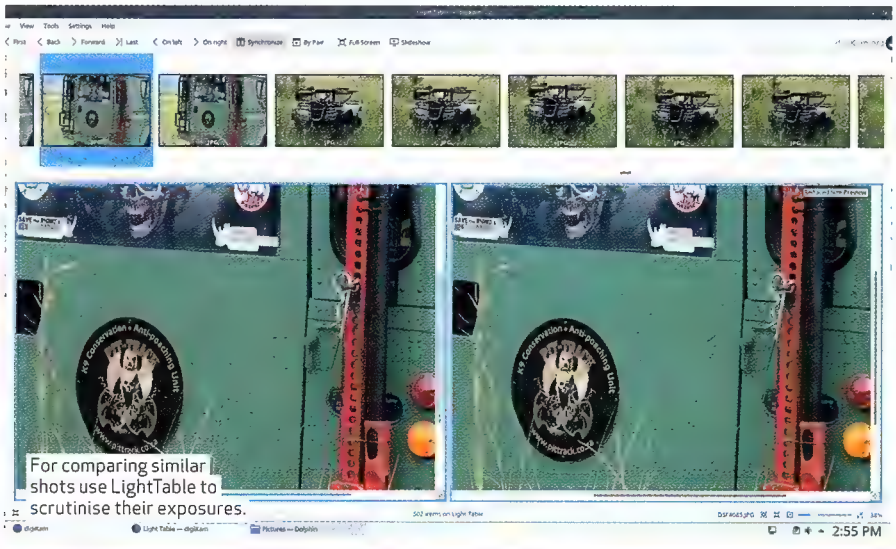
Labels perform a similar purpose in that they make it possible to add flags to your shots to filter later. If you're trying to whittle down a thousand images from an afternoon shoot to just a dozen, they're invaluable.

The simplest way to add a label is to right-click an image or selection of images and in the context menu go to Assign Labels. If you're working with a lot of images, though, mastering the shortcuts is essential.

'Alt-3', for example, will label an image as Accepted, while 'Alt-1' will label it rejected. You can then filter the thumbnail grid using the Filters menu to only show Accepted pics. Labels can be Picks, Colours or Ratings — it's best to choose one of the three to work with and stick to that for consistency.

The final tool for selecting images is the Light Table, which enables you to do side-by-side comparisons of similar shots. Open the Light Table, then drag-and-drop the images you want to compare into the two panes that appear. Each pane has its own information menu running vertically down the side. This is particularly useful because the exposure histograms for each image is in the Colors tab, so you can see if one is blown out while the other is perfectly exposed.

Throw in a passable raw converter and image editor, and you can see why digiKam is a compelling reason for photographers to opt for a KDE desktop environment. There's nothing quite as comprehensive as this photo management suite on any platform.

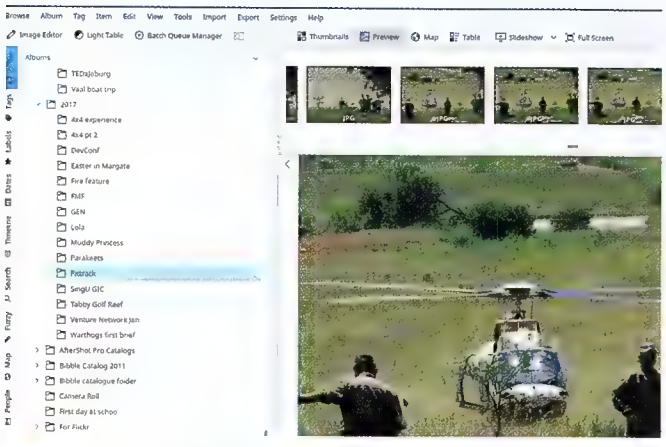


For comparing similar shots use LightTable to scrutinise their exposures.

Baking batches of photos

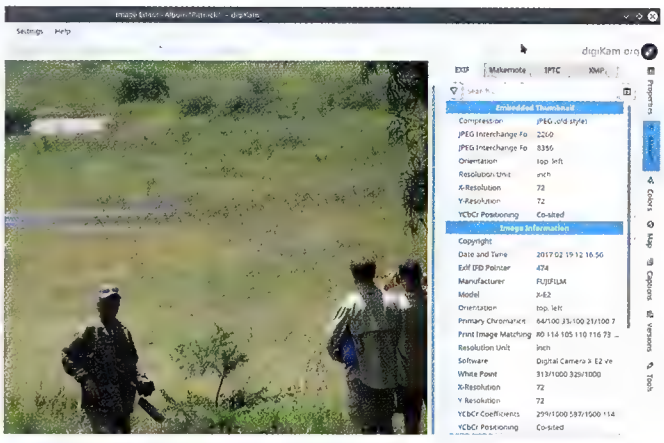
One of the standout features of digiKam is the Batch Editor. As its name suggests, it enables you to perform the same edits to multiple pictures as a group. While many other batch process tools exist for renaming or resizing photos, digiKam's editor makes it possible to perform any edits that you can apply to a single photo to a group of images. Either select a group of pics in the browser and open up the Batch Editor window, or drag-and-drop files into the left hand pane of the editor. Now you can build up a process by dragging tools from the Control Panel in the bottom right to the Assigned Tools space in the middle. In the top right pane, add tool settings such as the new size, metadata, effects applied or name. It's especially useful if you want to apply copyright (or copyleft) details to every pic.

Get to know digiKam's image editing tool



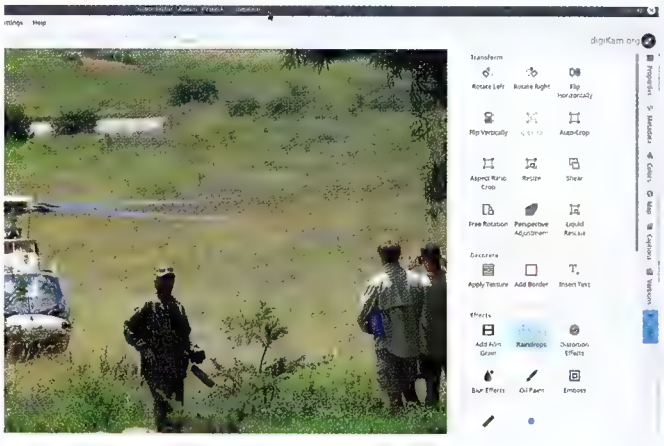
1 GETTING STARTED

GIMP or Krita will be the go-to tools for image editing for most Linux photographers, but for basic retouching, digiKam has a comprehensive suite of tools built-in. Select the image you want to change, then click Image Editor at the top of the screen.



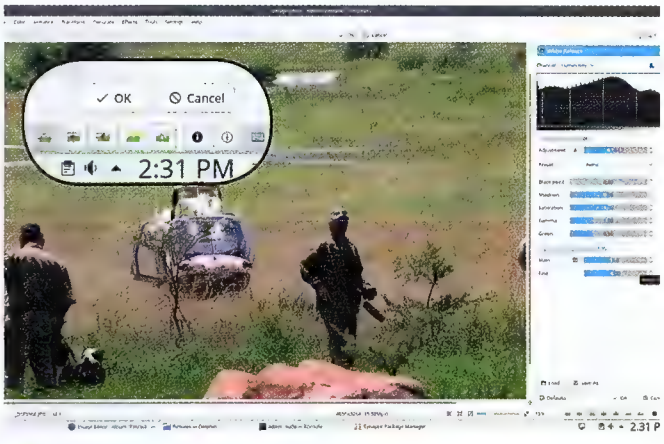
2 EDIT METADATA

The Image Editor has a vertical window on the right that gives you the ability to rewrite metadata and add captions to the photo in question. It also has a handy Versions tab, which makes it possible to see before and after takes of an edit.



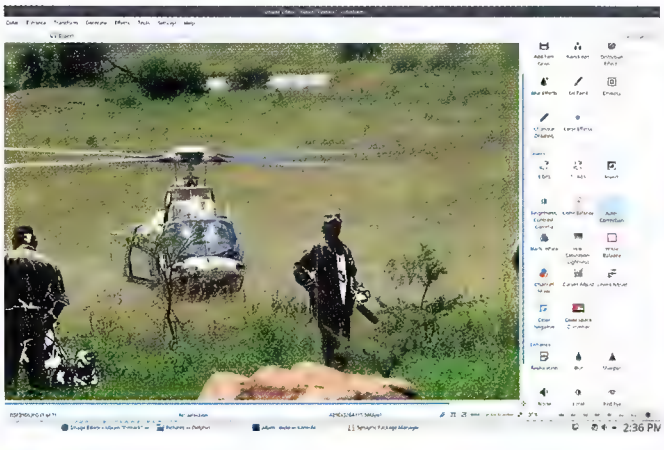
3 FIND THE TOOLS

All of the image-editing features are available from the menus in the window header, grouped under Color, Enhance, Transform and so on. For a more traditional feel, however, click Tools on the right to display a list of all the editing features as icons.



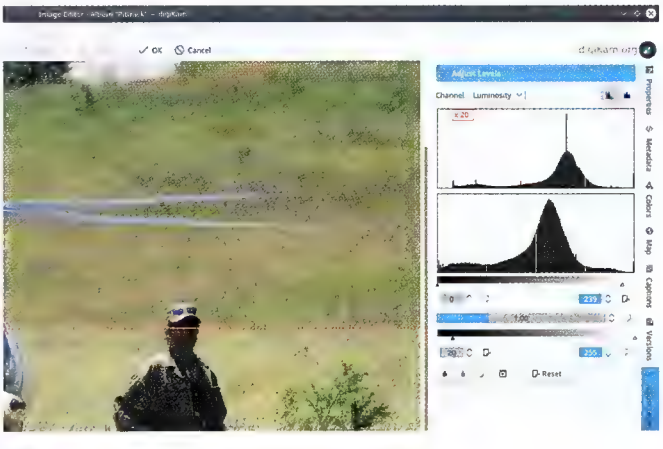
4 CHECK IT OUT

The tiny green icons along the base of the toolkit icon window enable you to see changes that you're about to make to an image on a split screen. This is handy if you're making global changes to the White Balance (which is the best place to start editing).



5 EXPOSURE CHECK

Next to the green icons, there are two information icons. One has a dark background, the other has a light background. These will highlight areas that are under- or over-exposed in a shot. For some quick fixes, try the Autocorrect button under Colors.



6 EXPOSED

The most important tool that everyone should master is the Adjust Levels tool. This shows a histogram of the brightness level across the photo. A well-exposed photo will be smoothly distributed across the range, so use the sliders to adjust your shot.

APC Labs' Z370 test PC

Zak Storey's Coffee Lake build hints at our new benchmark system.

THE CONCEPT

As consumers, it's our responsibility to give the industry crap if it's failing us. It's the very notion of a capitalist democracy: if you don't like something, change it; if you can't change it, make your voice heard.

People were fed up with four cores being the mainstream norm, so AMD responded with its Ryzen lineup. Eight months on, we're witness to Intel's response: Coffee Lake.

With its confusing architectural lineup, an increase in core count finally makes it to the company's mainstream processors. Although lacking some of the wow factor associated with a new architecture, at the top end, Coffee Lake provides six of Intel's highly refined Kaby Lake cores, with slight tweaks to power efficiency and base clocks, at a similar, if not identical, price. What you're left with is a processor capable of ripping up any multithreaded application, while retaining the title of single-thread processing king.

That's not to say it's perfect — the top-end part is hot, exceedingly so. The addition of those two extra cores hasn't come for free, and coupled with Intel's continued refusal to provide any form of suitable TIM material between the IHS and the die, you're left with a six-core, 12-thread part that can generate 80°C of heat at stock under load. That's hot, and not the sexy kind.

Coffee Lake's real gem is the Core i5-8400. At just $289, it's six cores and six threads of well-balanced performance, without the crazy temperature issues of the 8700K.

ALMOST BUDGET

The Core i5 series has always been centered around gamers. Its heritage goes back a long way, to the days of the Core i5-2500K and Sandy Bridge, as the chip of choice for anyone wanting to enjoy a casual gaming session. As such, it's one of the world's more popular chips, at least in the custom PC ecosystem.

This issue, we decided to recreate that idea of a perfect mid-range gaming system. One capable of driving what we consider the new mid-ground for resolution: 1440p with relative ease at 60fps. But what do you pair with a Core i5 to really give it a kick?

We knew we wanted to run a GTX 1070 in this build – our MSI Gaming X being a solid choice for that position. As far as 1440p goes, the GTX 1070 is the perfect budget GPU, bringing last-gen Titan X performance to mainstream prices.

On top of that, we threw in a healthy 16GB of DDR4, alongside a 480GB Crucial BX300, and a 1TB Seagate Constellation.2 2.5-inch hard drive – the latter being particularly important. Deciding to invest in a quiet 1,200W full-size PSU alongside a 360mm AIO meant we had to ditch the hard drive caddy for 3.5-inch drives below the PSU cover. However, Fractal includes a neat little 2.5-inch mounting tray behind the motherboard. Simply invest in a small-form-factor high-capacity HDD, and the problems are solved, leaving us with 1.5TB of workable storage for all our applications and media.

PARTS LIST

PART		STREET PRICE
CASE	FRACTAL DESIGN MESHIFY C	$159
MOTHER-BOARD	ASUS ROG MAXIMUS X HERO	$389
CPU	INTEL CORE I5-8400	$289
MEMORY	16GB (2X 8GB) CORSAIR VENGEANCE LPX @ 3,000	$229
GPU	MSI GEFORCE GTX 1070 GAMING X 8G	$669
PSU	1,200W THERMALTAKE TOUGHPOWER GRAND	$399
STORAGE 1	480GB CRUCIAL BX300 2.5-INCH SSD	$190
STORAGE 2	1TB SEAGATE CONSTELLATION.2 2.5-INCH HDD	$238
COOLING	THERMALTAKE FLOE RIING RGB 360 TT PREMIUM EDITION	$278
OS	WINDOWS 10 HOME	$199
TOTAL		$3,039

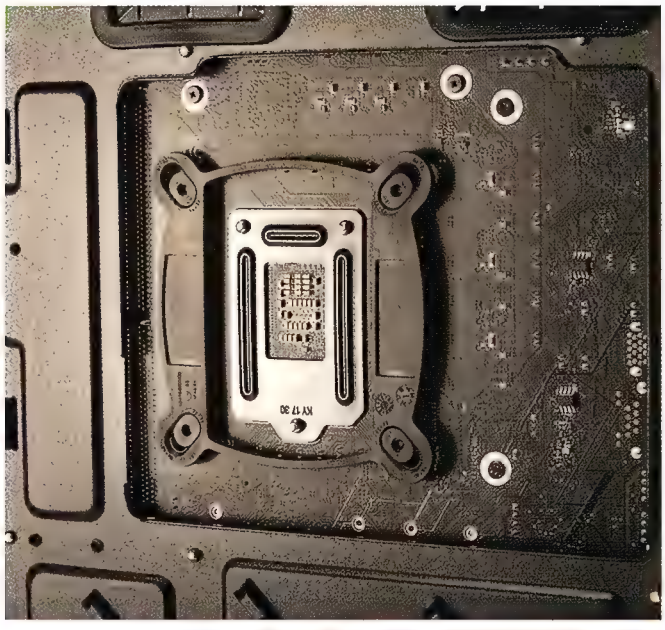
"You're left with a six-core, 12-thread part that can generate 80°C of heat at stock under load. That's hot, and not the sexy kind."

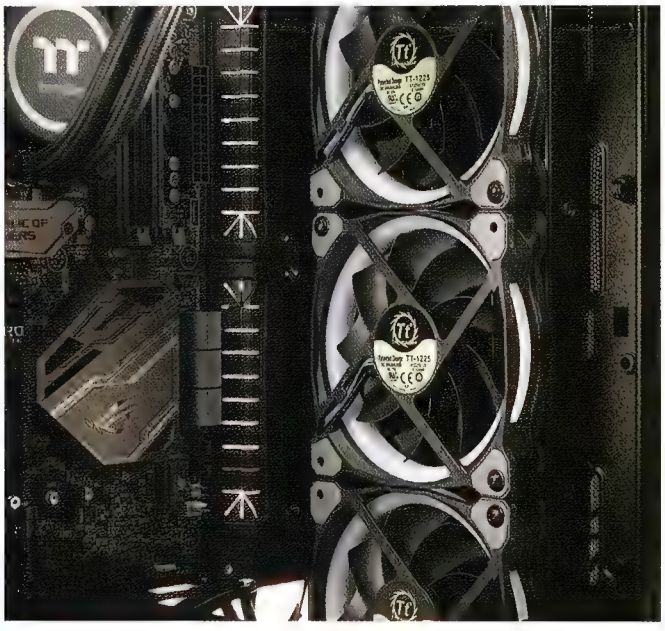
1 STRIP DOWN

When building a new system, we usually recommend that you strip your chassis down as far as you possibly can. Remove all the panels, and place them out of the way, in the box that the case was delivered in. This means that you won't damage the panels as you put your system together, and you'll have more room to work in. With the Meshify chassis, because the I/O is located on the top and front of the case, it's impossible to fully remove that front panel without damaging the cables. Simply put, carefully remove the panel only when you want to install fans or radiators in the front of the chassis.

2 MODULAR PSU INSTALLATION

Modular Power supplies are great for a number of reasons. For starters, they reduce the amount of cable clutter inside your build. They are often higher specced and more efficient than their non-modular cousins as well, and they tend to be easier to install, too. That said, when installing a PSU like this, you should figure out just what cables you're going to need to use, then plug them into the PSU while it's outside the chassis. It'll save you time and frustration in the long run, because there's nothing worse than clipping in those connectors under a cramped PSU cover, as in the Meshify C.



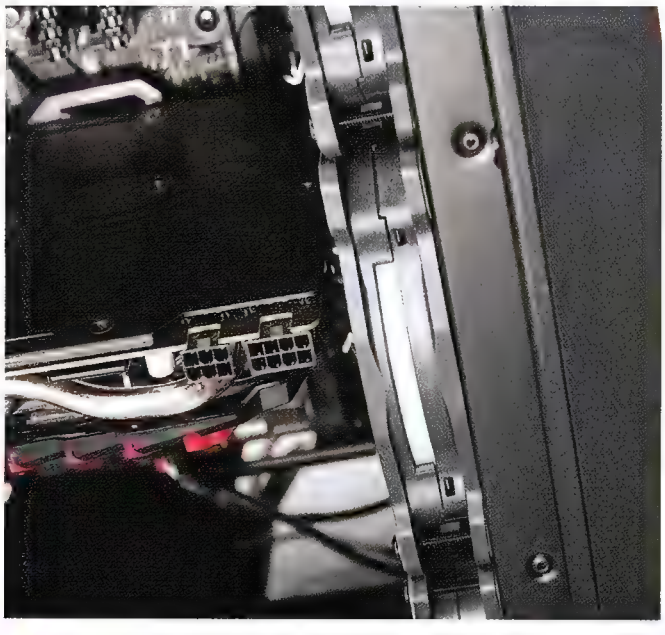


3 CUT-OUT HEAVEN

Generally speaking, when it comes to AIOs, you should almost always attach the backplate to the CPU block before you install the motherboard into the chassis, unless the case comes with a motherboard backplate cut-out like this. Fortunately for the Meshify, it's one of the cases where you can ignore the general rule — thanks to the tremendous size of the motherboard cut-out, you can install your motherboard first, then secure the backplate in place afterward.

4 360MM AIO

When it comes to all-in-one liquid coolers, you're often limited by the sizes on offer. Thanks, in no small part, to the patents that Asetek has taken out on its cooling technology, it can be somewhat challenging to find anything above 280mm in size. Fortunately, Thermaltake is one of the few manufacturers that still go up to and beyond that 280mm limitation. The 360mm Riing Floe is perfect for any toasty Coffee Lake processor — even our Core i5-8400 sits merrily at just 40°C. There are some additional superfluous cables that come with it, which connect to a USB RGB fan hub, but that aside, this is the perfect AIO for our build.



5 TIGHT SPACES

We're quite fortunate we didn't pick a larger GPU. Although the Meshify C is technically an ATX midi tower, it's worth remembering that C notation in its name. It stands for 'compact'. And it certainly is. Install a full-length rad in the front, and GPU length suddenly becomes food for thought. If you do decide on a longer card, yet still want to retain that cooling, you'd have to drop down to a 240mm AIO, and mount it in the roof instead, then install three additional fans in the front, for better air intake.

6 I/O LACKING?

One of the better features that Asus has started to include on some of its motherboards is an integrated backplate. No more installing (or completely forgetting to install, in our case) I/O shields — you simply need to line your motherboard up, install it, and job done. However, we've got to admit that, for a $389 motherboard, the Maximus X Hero is running a little thin on the ground when it comes to rear I/O. We would have liked to see more than the mere seven USB ports that are included here — today's age of USB peripherals galore could lead to a shortage of suitable connections.

1 ASUS has really worked hard on integrating its M.2 heatshields into the design of its mobos. They look great, and help to alleviate thermal throttling during heavy sequential workloads.

2 Unfortunately, Thermaltake's Floe Riing RGB tech isn't compatible with other system sync RGB software setups, such as ASUS's Aura Sync or MSI's Mystic Light.

3 BIOS debug codes are exceptionally useful when it comes to diagnosing exactly what's going on if your system isn't booting. Spoiler: it's usually memory.

4 Yeah, we're not really sure why Thermaltake decided to put the tubes in front of the logo either.

Full of beans

We've thoroughly enjoyed the processor race of the last year. From Kaby Lake to Ryzen to Coffee Lake, 14nm has produced some absolute gems. And we can safely say that older parts – even our favourite, the Intel Core i5-2500K – might finally be drawing their last gasps, as single-core performance and core count increase so dramatically.

All in all, this build was a pretty smooth ride. We had a few issues with placement fairly early on, but it all worked out in the end. The triple rad in the front caused the most issues. We did intend to use a 2TB 3.5-inch drive in the lower hard drive cage, under the PSU cover, but as we had a large PSU and that rad in the front with the fans, we couldn't fit it all in, so had to use a 2.5-inch instead. Not the end of the world, but we do expect it to affect performance in games and media load times. We were saved by Fractal's mounting tray across the back of the motherboard cut-out, which supports up to three 2.5-inch devices.

More Thermaltake rage came in the form of the cooler's RGB fans. Fortunately, they only have one cable, but they are USB-headed, and plug directly into an included USB hub, which then plugs into a molex power, then into a USB port on the motherboard, forcing you to use Thermaltake's software, and adding excessive lengths of cable to the build – less than ideal for the Meshify's already ompact compartmentalisation.

Moaning over. How was the performance? Pretty damn good. It's amazing how far Intel has come just by adding two more two cores to the majority of its lineup. Seeing those multithreaded scores climb as high as 956 points, for a $289 part, is pretty awesome for Team Blue. That's just a touch off the pace of our zero-point's overclocked Core i7-6700K. But if you compare the Core i5-8400 against its $245 competitor from AMD, the Ryzen 5 1500X, it starts to paint a better picture. Single-core performance is 12 points higher, multi-core 150 points higher, and you don't have to worry about potential memory compatibility issues. The big difference lies in Intel's reluctance to unlock all of its processors, though. Hypothetically, you can still overclock the 1500X, eking out just enough performance to surpass its competitor.

So is this the core to have? We'll let you decide, but for a mid-range build, it's perfect for demolishing that 1440p target alongside a GTX 1070. We saw average frame rates at 1440p sit comfortably at 67 and 64fps in *Far Cry Primal* and *The Division*, respectively, with 38 and 35 in *Total War: Attila* and *Rise of the Tomb Raider*. It's a cool, well-equipped rig, with enough grunt to future-proof you for the next five years, minimum, and that's something we can definitely get behind.

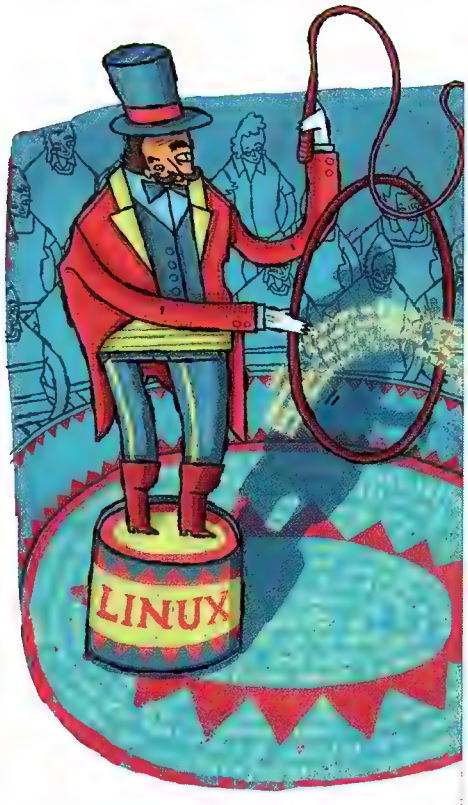
BENCHMARK RESULTS

	OLD APC LABS TEST PC	THIS SYSTEM
CINEBENCH R15 MULTI-THREAD	987	956 (-3%)
CINEBENCH R15 SINGLE-THREAD	196	166 (-15%)
TECHARP'S X264 HD 5.0.1 (FPS)	21.93	21.43 (-2%)
CRYSTALDISK QD32 SEQUENTIAL READ (MB/S)	1,895	525 (-72%)
CRYSTALDISK QD32 SEQUENTIAL WRITE (MB/S)	949	475 (-50%)
RISE OF THE TOMB RAIDER (FPS)	41	55 (34%)
THE DIVISION (FPS)	78	91 (17%)
3DMARK: FIRE STRIKE (INDEX)	15,026	15,440 (3%)

Our old *APC* Labs Test PC uses a Core i7-6700K CPU @ 4.6GHz, an AMD R9 Fury X, and 32GB of RAM. All games are tested at 1080p on max settings, with HD texture packages installed.

Host a personal Pi-powered wik

Stuart Burns shows how to build a wireless wiki server on the tiny Raspberry W computer, before storing it away in a quiet corner of your home.



Since the original Raspberry Pi arrived, there have been many changes from the original, including more cores, more functionality and more RAM. All these features are good, but the Raspberry Pi foundation is going back to minimalism with the new Pi Zero W.

The Zero W is all about mobile computing in a tiny package with built-in wireless networking (hence the W monicker) and for a bargain price at around $15. While the Zero W may not be as powerful as the new Pi 3, its performance is good enough for tinkering, thus staying true to the original Raspberry Pi ethos. In this tutorial, you'll discover how to use the Zero W to create a wireless and headless wiki. It's a portable wiki in your pocket!

If you're thinking of purchasing a Pi Zero W then you'll need additional converters to use the USB and HDMI connection, because all the I/O ports on the device are all micro sized. Thankfully, most Pi vendors will stock the set of required connectors.

The first step you need to perform is create a bootable MicroSD card with an image of the Raspbian OS. Because of the limited nature of this platform, we'll be using the Raspbian Lite edition rather than the full fat desktop version. The Raspbian lite software image can be found hosted at **downloads.raspberrypi.org/raspbian_lite_latest**. We'll be using the direct download rather than the torrent file. Download the zip file to your PC.

When you open the zip file, only the image file (ending in .img) should be extracted. Some archive extraction tools will also open up the image file. Make sure that you have just the one image file after the extraction process.

Although it's possible to write the image to the MicroSD image in the old-fashioned way of using the `dd` command, we recommended that you use the new GUI with the sole purpose of writing out SD images. Indeed, this approach comes recommended by the Pi makers themselves. This new program is called Etcher. It's free to download and works on all major platforms.

Using Etcher takes out the complexity of the `dd` command. It also means no more accidental overwriting of the wrong storage or fiddling with other undesirable outcomes.

CATCHING ETCHER

Download Etcher from **etcher.io** and install the Linux version. To run it, you only need to unzip the application and double-click it, rather than having to spend time installing it with package management systems. On the initial run the application will set up a few configuration items and offer to create a shortcut for future use. Using Etcher to write the image is certainly the way forward!

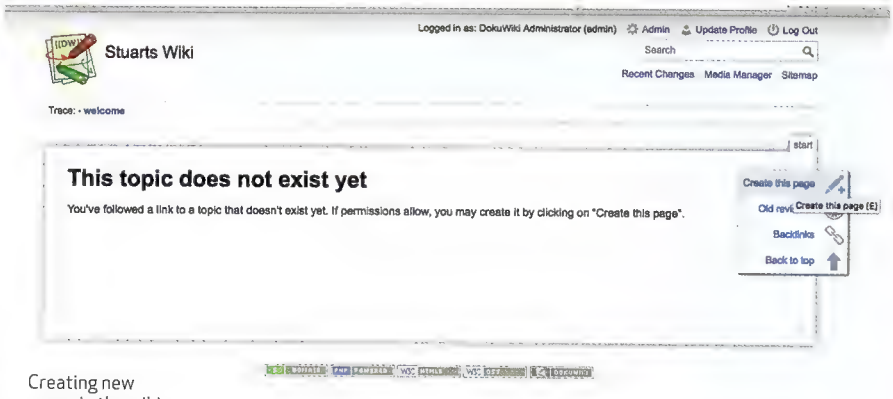
Once you launch the application, you'll see that there are only three buttons for the entire application and only two items that need to be configured: the source Raspian image file and the destination (the MicroSD card). Click the Source button and navigate to the unzipped Raspbian image that was extracted earlier. Next, select the appropriate MicroSD card as the destination. Finally, press Go. The process will take several minutes to write out and then verify the image.

At this point, you should be able to transfer the MicroSD card to the Pi and boot from it. The default username and password is 'pi' and 'raspbian'. The changes we make at this point including configuring the wireless, updating the OS, setting the static network configuration and installing open SSH to enable remote access. Use the code below to list the available SSIDs (networks):

```
sudo iwlist wlan0 scan
```

As well as listing accessible SSIDs, it also proves that the Pi can see the wireless networks. The first step is to edit the SSID and password for the network that's to be used. To manually specify the encryption password, edit the following file to automatically enable the wireless networking in future:

```
sudo nano /etc/wpa_supplicant/wpa_supplicant.conf
```



Creating new pages in the wiki is straightforward.

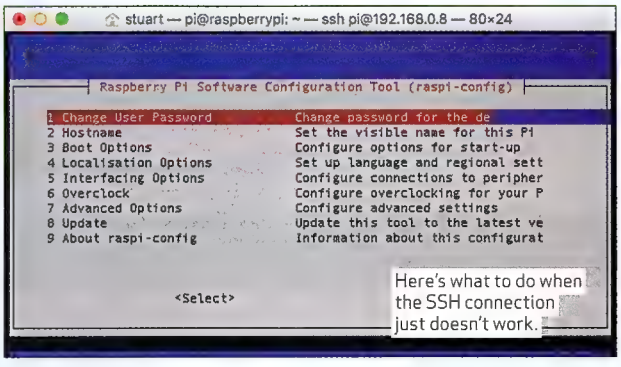
For when SSH doesn't work as expected...

When installing Raspbian, there's sometimes an obscure error regarding no available algorithms. The issue will only show up when a user tries to login remotely using SSH. Troubleshooting SSH login can be done by specifying the `--vvv` key. For reasons unknown, when OpenSSH server is installed, it doesn't correctly generate the keys. The fix for this issue is to manually regenerate the keys in question.

This error will show up with a message along the lines of "No supported key exchange protocols available" when used with the `--vvv` debug step. Verify the absence of the protocol by logging into /etc/ssh and looking at the public and private keys. If they are zero size, it means that the reader has the issue.

The regeneration needs to be done for each protocol. This particular regeneration was fixed with the following commands:

```
ssh-keygen -t rsa -f /etc/ssh/
ssh_host_rsa_key
ssh-keygen -t ecdsa -f /etc/ssh/
ssh_host_ecdsa_key
ssh-keygen -t ed25519 -f /etc/ssh/ssh_
host_ed25519_key
```



Here's what to do when the SSH connection just doesn't work.

Once the regeneration of the keys has been completed, we'd suggest restarting the SSH server for good measure, to ensure that everything is clean.

Rather than expose the password in plain text, we can specify the wireless network and encryption key and have it auto-populate the 'wpa_supplicant.conf' file. To generate the contents of the file, it's possible to run the `wpa_supplicant` command. This will effectively create all the data required to obtain a wireless connection and pipe it to the screen. This is good in itself, but it's more useful to redirect the output to the configuration file. Doing so will avoid the possibilities of any copy and paste configuration errors:

```
sudo su -
wpa_passphrase "SSID"
"Password" >> /etc/wpa_
supplicant/wpa_supplicant.conf
```

The SSID portion above should contain the network that's to be used (the one that you'll connect to when using a laptop, for example). The password should be the plain text network password that was used earlier.

WHAT'S YOUR IP?

After configuring the wireless aspect, the second part of setting up the network is to establish the IP address for the wireless network. Using a static IP address for servers is considered best practice: it's much easier to manage and the IP is retained on reboot. To change the network IP to a static one, find an address that's not in use and note it down. You can then use the `ping` command to find an unused IP address (assuming that no firewalls are blocking responses). To modify the Pi and set a static IP address edit the interfaces file. Use the nano text editor to do this.

```
sudo nano /etc/network/
interfaces.
```

There are several lines that need to be changed. Alter the line for DHCP to static and enter the following lines. The settings below should be fine for most networks with the exception of the IP address. Substitute an unused IP address on the network for the one below. If the network in question is different (for example, if you have a 10.0.0.0/24 address), then you'll need to modify the gateway and netmask as well as the IP address. As they say, your milage may vary!

```
iface wlan0 inet staticsuper
bad message plant.
    address 192.168.0.8
    netmask 255.255.255.0
    gateway 192.168.0.254
    dns-nameservers 8.8.8.8
8.8.4.4
    wpa-conf /etc/wpa_
supplicant/wpa_supplicant.conf
```

Save these changes out by using 'Ctrl-X' and the administrator will be prompted to save the file. To make sure the network comes up clean we suggest a reboot at this point. Failing that, a network services restart can be performed by using the following command:

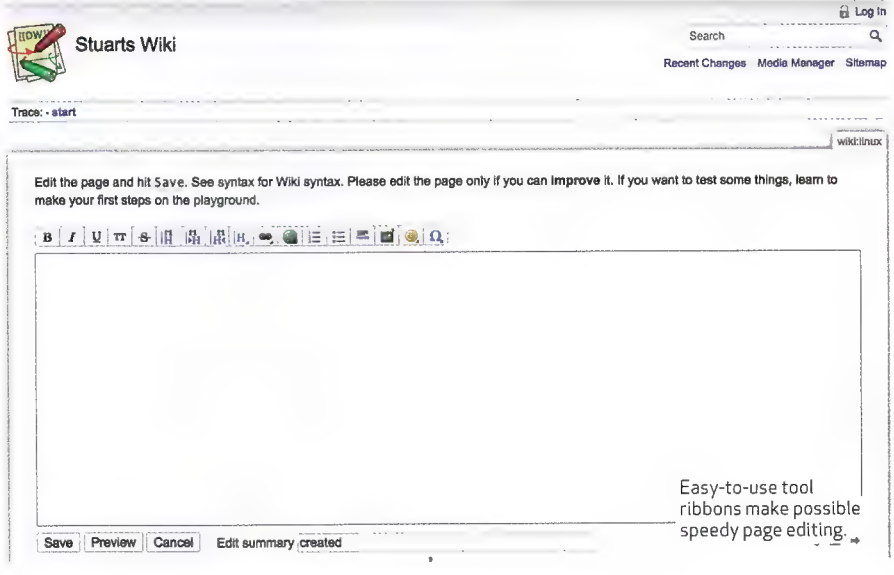
```
/etc/init.d/networking
restart
```

We also advise pinging the Pi from a different computer to ensure that the network is correctly configured.

Update the OS by using the command below, which will also reboot the computer. Although it may look a little clumsy the process updates and upgrades all the software to the latest releases, before rebooting:

```
sudo su -
apt-get update -y &&
apt-get upgrade -y && reboot
```

Now that the base installation is set up and visible on the network, the OpenSSH server needs to be installed



Easy-to-use tool ribbons make possible speedy page editing.

to enable remote management of the Pi:

```
sudo apt-get install openssh-server -y
```

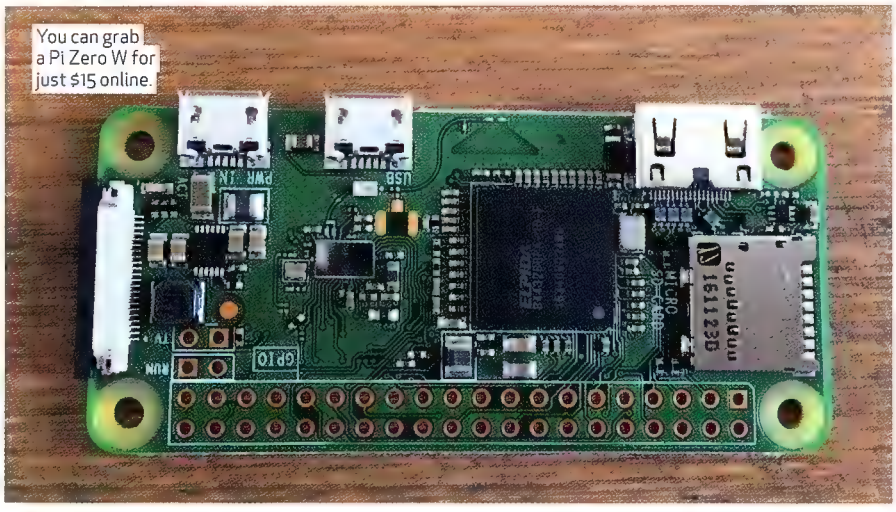
To enable the OpenSSH interface, the reader can use the raspi-config application. Navigate to the interfaces line on the GUI and select the SSH option. To launch the raspi-config tool, just type the command `sudo raspi-config` at the command line. While in the raspi-config tool, you can also change the host name from raspberrypi to anything you like. Then exit the program and check that SSH access is working by logging into it from another Linux machine using the command `ssh pi@static_ip_address_just_set`.

Finally, we need to address the HDMI interface. By default, the system may not boot if the HDMI interface isn't enabled (plugged in). So you should make a quick edit to enable the system to boot without the HDMI cable being plugged in:

```
sudo su -
echo "hdmi_force_hotplug=1" >> /boot/config.txt
```

Once this is done and the system can boot without the HDMI, you can hide the Pi out of sight. If you experience any problems, plug the cable back in and it should boot normally. You may need to remove and reconnect the power, however. A reboot and remote login via SSH will enable you to check that the system is up and running, and you can configure it remotely as required, too.

There's a known problem with OpenSSH not always installing and creating the public and private keys correctly. The fix is explained earlier in this article (see boxout 'For when SSH doesn't work as expected...' back over the page). Assuming all is working, it's time to move on to building the wiki.



LAYING THE WIKI GROUNDWORK

Start by installing Apache and the required Dokuwiki dependencies using the command below via SSH on the newly remote enabled server:

```
ssh pi@192.168.0.10
sudo apt-get install apache2 libapache2-mod-php
sudo a2enmod rewrite
service apache2 restart
```

To make sure Apache is up and running, use a web browser and attempt to open the IP address of the server. It should hopefully show the default Apache website.

It's now time to modify configure the Apache server for the wiki installation. The code below performs a few simple steps. First, it moves into the web root directory and downloads the latest edition of docuwiki. It then unpacks the docuwiki installation into a sub-directory of the Apache web folders so it can be accessed within the current http directory structure. Next, it changes the ownership of the files to the correct owner (www-data):

```
cd /var/www
sudo wget https://download.dokuwiki.org/src/dokuwiki/dokuwiki-stable.tgz
sudo tar xvf dokuwiki-stable.tgz
sudo mv dokuwiki-*/ dokuwiki
sudo chown -R www-data:www-data /var/www/dokuwiki
```

The last step is to change the Apache document root to point to the new dokuwiki folder. Open the Apache configuration file using the following command:

```
sudo nano /etc/apache2/sites-enabled/000*.conf
```

Locate the 'DocumentRoot' line and replace it with:

```
DocumentRoot /var/www/dokuwiki
```

Save the changes and type the following to restart the Apache service to update the service with the changes you've just made:

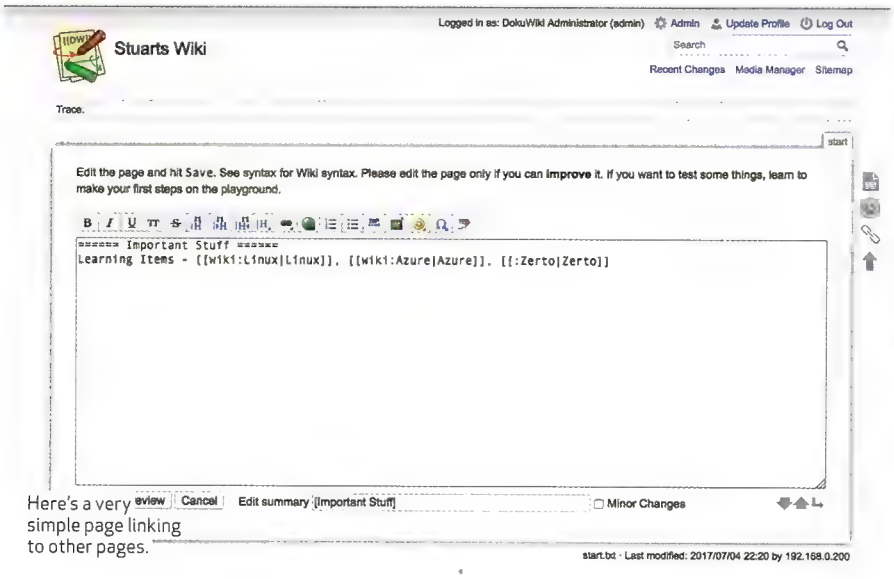
```
sudo apachectl restart
```

All that's left to do now is to configure the wiki software. The Dokuwiki setup only needs to run the web-based install program. Open a web browser and point it to the URL as shown below, making sure to swap in your IP address. The format should be:

```
http://192.168.0.10/install.php
```

You may get a warning: "PHP function utf8_encode is not available". Fixing this issue is as simple as issuing the command shown below:

```
sudo apt-get install php-mbstring -y
```

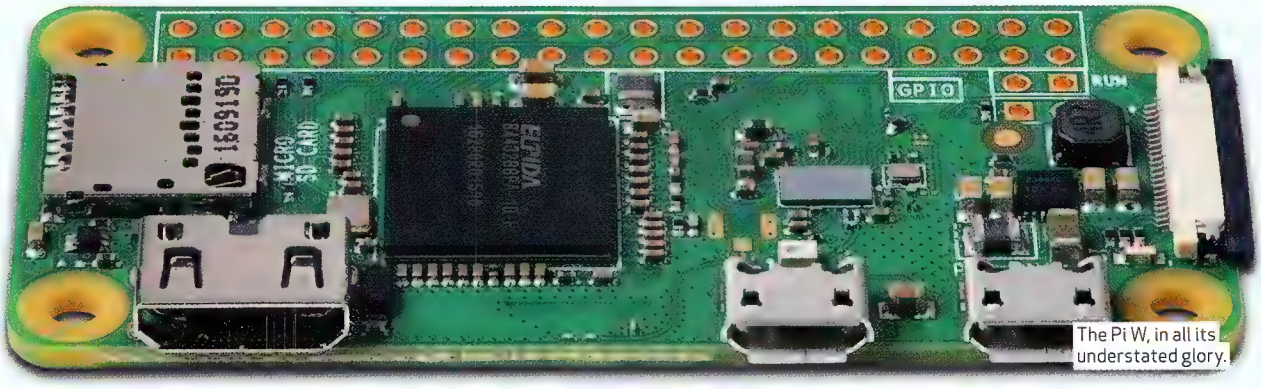


Here's a very simple page linking to other pages.

A pi for every occasion

Originally, there was only the Raspberry Pi. Now there are several models available. The Pi Zero W used in this tutorial is a 1GHz single-core machine fitted with 512MB of RAM. While that may seem a little low, the Zero is designed for embedded use with very small power requirements. The device's tiny size (65 x 30 x 5mm) makes it ideal for projects that don't require huge amounts of power but do require flexibility. Indeed, with these tiny, low-powered boards, there's a huge amount of flexibility not only with the connectivity options but also when powering the device. Some tinkerers have gone as far as powering them with solar panels and plain old batteries.

This flexibility makes them ideal for tasks like rainfall monitors, temperature sensors and other data collection tasks made possible from the Pi Zero W's wireless functionality. And if should something happen to the device, replacing it is both inexpensive and quick. An all-round winner!



The Pi W, in all its understated glory.

Once this is updated, the installation will be able to continue as normal.

The great thing about dokuwiki is that it's so simple to use. There are no databases or complex subsystems to configure. The installation of the wiki itself is only one page! On the setup page, give the wiki an appropriate name. You also need to configure the superuser on this page. Fill in the username (something short and useful), real name, email and password.

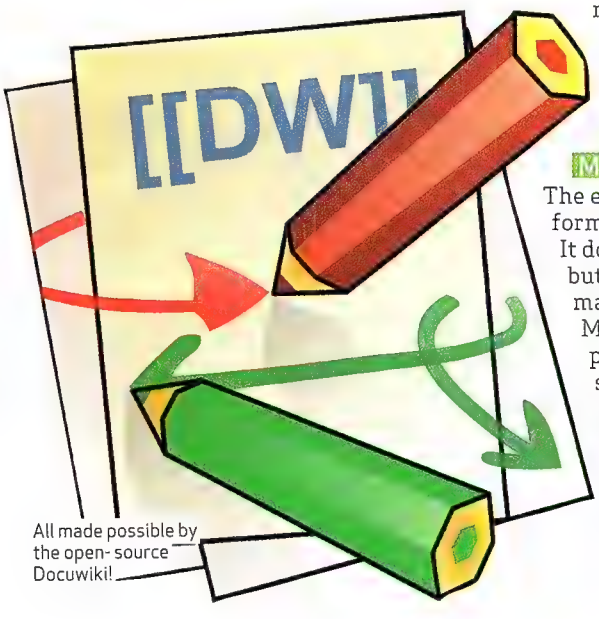
The ACL policy also needs to be set. For a home network, a closed policy with named users is probably the best plan. Finally, unless there's a specific need, set licence to "Do not show license information". Then click save. The setup process is now complete so click the 'Continue to Wiki' hyperlink. You should be able to log in using the credentials you set up a moment ago.

On completion of the setup, we recommend that the administrator log into the Pi and remove the install.php. If you leave it in place, it enables people to reconfigure the system. Do this by sshing into the Pi, logging in as user 'pi':

```
ssh pi@192.168.0.10
```

Then use this command to remove the install file:

```
rm /var/www/dokuwiki/install.php
```



All made possible by the open- source Docuwiki!

EDITING AND MANAGING PAGES

The entire wiki is a simpler form of text markup language. It doesn't use HTML but rather a propriety markup that's simple to use. Major headings are prefixed with six equal signs (======) and closed again with the same. Creating links to other pages is as simple as using the following style of markup language.

To link to a page, give it a page name and then enclose it in double square brackets. For example: [[mygreatsetupage]].

The page now becomes part of the wiki. Essentially, there's no need to create the page manually.

The setup is now complete. While this is just a simple example of what can be achieved with the Pi Zero W, it shows how versatile it can be. What's appealing here is that there's no need to create a virtual machine or modify your local computer to set up the wiki.

This wiki setup was purely an example of what is possible on these fantastic little devices.

One word of warning, though. If the device is moved to a new location, it's important that the shutdown is done correctly. From what we've experienced and found by reading up about it online, it looks like the Pi is much more suspectable to power loss than most other systems. Therefore, make sure that it's shut down properly by using the `sudo shutdown -h now` operation to shut it down cleanly.

Lastly, make sure you make a backup of the wiki and keep it somewhere safe. There's some great back-up advice over at **www.dokuwiki.org/faq:backup**.

Watch TV on Android using zero data

How do you watch live free-to-air TV on your Android device without using your data? Use a USB digital TV receiver module. Darren Yates explains.

With YouTube, Netflix and Stan, finding something to watch on your Android device isn't too difficult. Throw in the arrival of Freeview FV and you can even watch free-to-air TV over Wi-Fi or your mobile network connection. However, the downside is they all require slurping on your internet plan's monthly data quota, whether you're on ADSL, NBN or just mobile data. But there is a way to receive digital free-to-air TV on your Android device using no data at all and costs just $20 or so to set up – and that's using a USB DVB-T receiver dongle.

REALTEK RTL2832U

When digital TV receivers for the PC first hit the market, they were the size of a graphics card and required a full-length PCI slot. Thankfully, not long after, USB stick versions arrived, making it possible to watch TV on your notebook PC. However, at the time, none of these receivers came with Android software. That's not really surprising given that, up until not long ago, mobile devices, other than laptops, just didn't have the horsepower to decode 'digital video broadcasting – terrestrial' or 'DVB-T' signals and display them in full-screen glory. The other issue was that no DVB-T dongle came with even Android device driver software or microUSB ports to fit Android devices.

Then about three years ago, the planets started to align and the first microUSB DVB-T dongles for Android began to filter through. We planned to do this story a couple of years ago and duly purchased a low-cost dongle online. Unfortunately, this particular unit drove me nuts – it came with an Android DVB-T app on disc, but upon installation, it had the wrong channel information for Australia and, to this day, still can't register any of the local DVB-T station channels. It now serves as my reminder of what can happen when you buy unsupported hardware online.

Meanwhile, USB DVB-T tuners for PCs have continued to fall in price, helped along by audio and network peripheral chip maker Realtek. New USB dongles featuring Realtek's RTL2832U chip have since become a popular low-cost option and you'll find these selling on eBay for as little as $10. The RTL2832U itself is a decoder or 'demodulator' chip and has to be paired with a digital signal tuning chip in order to shine. Most USB dongles will pair it with a Rafael Micro R820T (DVB-T) or R820T2 (DVB-T2) tuner chip. The R820T should be fine Down Under.

AERIAL-TV

Then in early 2017, a new beta app arrived on Google Play called 'Aerial-TV'. Along with driver software for the RTL2832U chip, the app enabled these dongles for the first time to receive free-to-air digital TV broadcast signals and display them on Android devices. The app soon disappeared, however, but has recently returned. After its 30-minute trial period, it'll cost you about $7 to keep, but so far, it's the only Android app that works with these RTL2832U/R820T dongles, so it's not a huge cost. Plus, it picked up every DVB-T channel available in my local area, which is an excellent start.

HARDWARE REQUIRED

So to make this work, here's what you will need:

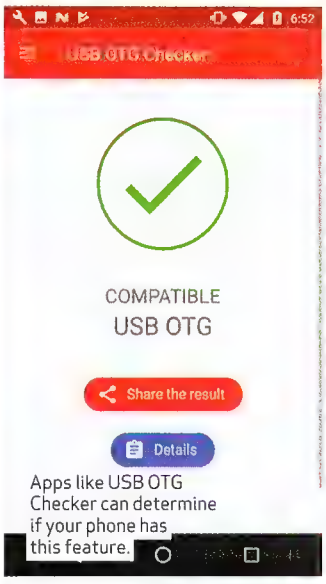
- Android phone or tablet with USB-OTG port and Android 4.1 OS or newer
- USB DVB-T dongle with RTL2832U/R820T chipset
- USB-OTG cable
- Aerial-TV app from Google Play (**tinyurl.com/ya876vvz**, 30-minute free trial, $6.49 to keep)
- RTL2832U drivers from Google Play (**tinyurl.com/yddwckky**, free)
- MCX-to-PAL antenna adapter cable (optional for TV aerial)

If you live outside of a metro area (or you're a fair distance from your local TV transmission tower), you'll likely need a decent TV aerial to pick up sufficient signal, in which case, an MCX to PAL adapter cable will come in handy. Most RTL-based DVB-T dongles use the smaller MCX connectors and adapter cables go for $2 or so on eBay.

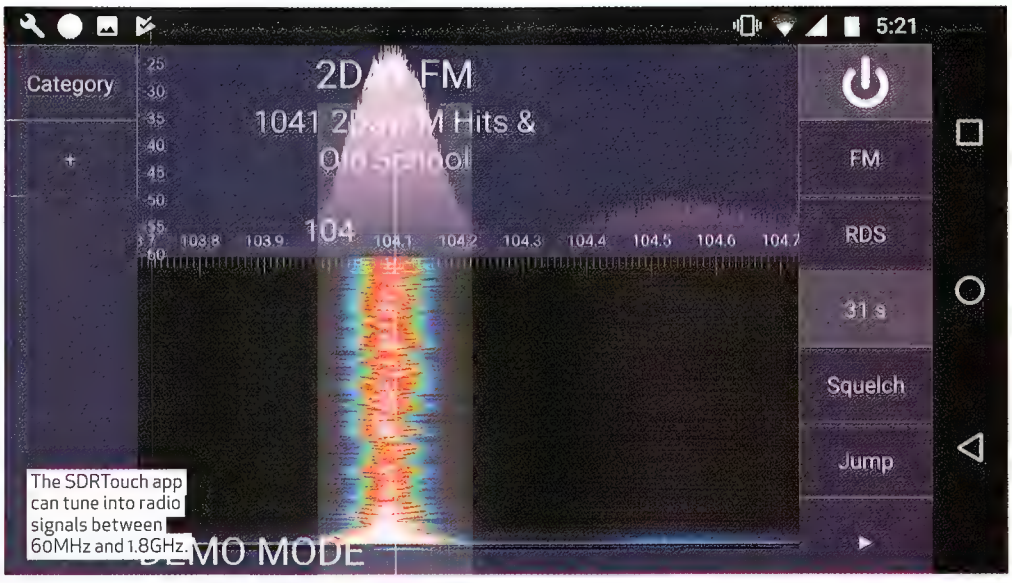
GIVE ME POWER

Now there's one important issue in watching DVB-T telly on your phone – because of the way USB-OTG works, your phone expects to supply power to run the DVB-T dongle, which is going to knock down the overall battery run-time. Testing with an in-line USB voltage-current meter revealed our recently purchased RTL2832U/R820T dongle pulled approximately 300mA of current. What's that mean in practice for battery life? If you have a phone with a 3,000mAh battery normally

Pick up an RTL2832U-powered DVB-T dongle from eBay for under $20.



Apps like USB OTG Checker can determine if your phone has this feature.



The SDRTouch app can tune into radio signals between 60MHz and 1.8GHz.

lasting you 10 hours of continuous 'screen-on' use, expect it to now only run for five. It may be possible to use a powered USB hub, but we haven't tried it, nor do we know what effect doing so may have on your Android device.

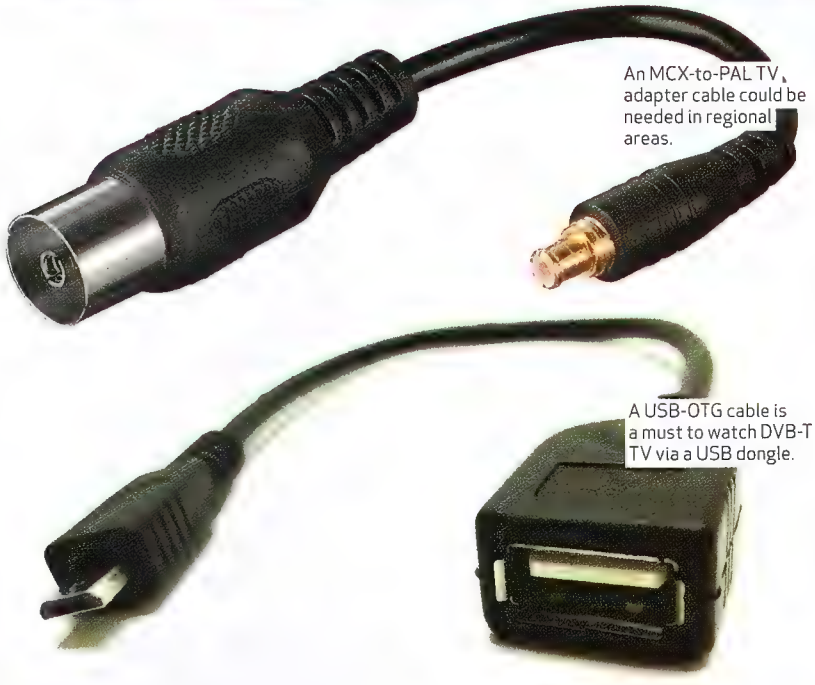
One last thing, the app-makers claim Aerial-TV currently only supports second-generation DVB-T2 TV reception via USB dongles with Rafael Micro's newer R828D tuner chip. However, since Australia still only uses first-generation DVB-T transmission standards at time of writing, an RTL2832U/R820T combo should be fine.

SETTING UP

Putting everything together is just like following links in a chain – start by installing the RTL2832U drivers from Google Play, followed by the Aerial-TV app. Plug the USB DVB-T dongle into the USB-OTG cable, plug your aerial into the dongle, then plug the USB-OTG cable into your Android device. Launch the Aerial-TV app and it should ask for permission to use the USB-OTG device. Set it as the default device at the same time. Soon after, it'll want to do a channel search – allow it to do so. It'll take around three minutes or so to go through the DVB-T radio-frequency band, but in our test, the app, which receives regular updates, surprised us in finding all of the local Sydney stations, a decent effort given the frequency changes to DVB-T in Australia in recent years.

However, between first installing the app and receiving the latest update, the app has gained an unfortunate green stripe down the right edge. We hope this is fixed soon. Otherwise, the app works well – no AV sync issues, smooth and steady frame rates and you can even change the aspect ratio.

We tested this hardware/software setup on a Motorola Moto G5 phone, with its eight-core ARM Cortex A53 processor, 2GB of RAM and Android 7.0 operating system – not a flagship phone, but no slouch either. Yet, while everything worked nicely on standard-definition '576p' channels, the phone struggled with all of the HD-designated channels. We had audio, but only occasional pixelated video frames. Whether this was a software issue, or a lack of CPU power to decode and display 720p and 1080p-resolution broadcasts, we're not sure. The app has no recording option, but choosing a channel is as simple as swiping the horizontal menu of detected channels across the bottom of the screen.

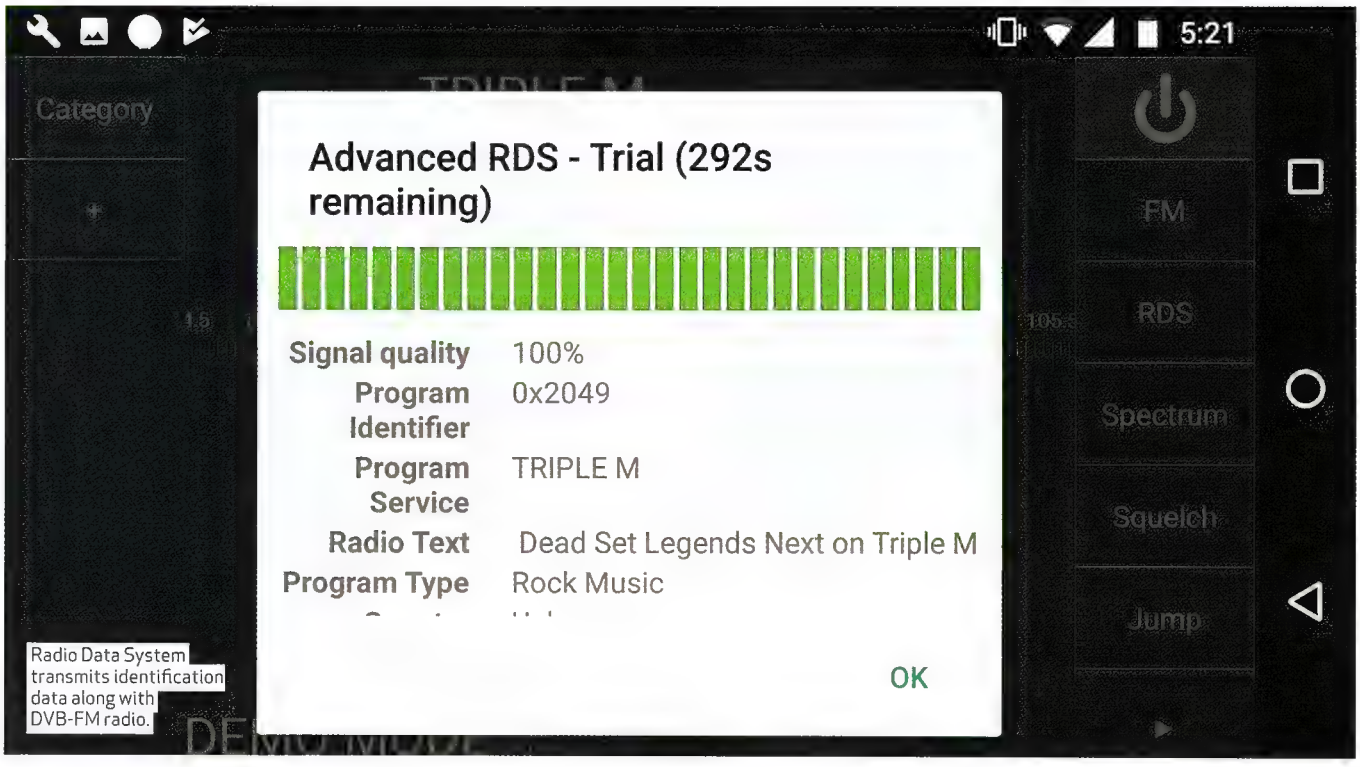

An MCX-to-PAL TV adapter cable could be needed in regional areas.

A USB-OTG cable is a must to watch DVB-T TV via a USB dongle.

SOFTWARE DEFINED RADIO

DVB-T broadcasts aren't the only radio-frequency transmissions this RTL2832U dongle picks up. Before computers and Wi-Fi became mainstream, serious geeks were enamoured by radio communications, not just Morse Code or voice, but how the actual transmission of radiowaves worked. Some would even spend their weekends building their own radio transmitters and receivers, then use them to communicate with like-minded folk from far-away places. While it's still a hobby for some, it's been a vital communications link for others, particularly for 20th- and 21st-century outback Australia. It was key in setting up the Royal Flying Doctor Service and its still used today by kids enrolled in the 'School of the Air', a government-led virtual school system taught over high-frequency radio for kids in remote locations.

Australia's increasingly valuable radio frequency spectrum means 'amateur radio' enthusiasts have a smaller sandpit to play in these days. It also still requires a licence to transmit over much of the 'amateur



bands' remaining. However, pass the exams and you can obtain an amateur radio licence from the Wireless Institute of Australia (**wia.org.au**), under the watch of the Australian Communications and Media Authority (ACMA) and operate your own low-power amateur radio station. Small slivers of spectrum space are still made available by the ACMA for amateur radio and television transmission use.

While the transceivers used have, for the most part, required complex electronics to develop the power to shift radio signals over distance, even the less-complex receivers have had their limitations, either receiving just a small section of the spectrum or only receiving certain types of signal transmissions. The overall complexity of these devices, however, kept prices relatively high.

By the early 1990s, electrical engineers, mathematicians and software engineers were getting their heads together to nut out the possibility of creating radio transmission and reception on a much more efficient scale. The US Air Force and the Defence Advanced Research Projects Agency (DARPA, the team who first put autonomous vehicles on the map) got involved with the idea of creating a radio that could handle all different types of communications over the previously unheard-of frequency range of 2MHz to 2,000MHz. It eventually became 'software-defined radio' (SDR), radio communications created and controlled by software. It was still expensive, but the wheels of progress were now turning in the right direction.

Wind the clock forward about 15 years and audio/network peripheral chipmaker Realtek begins pumping out the RTL2832U DVB-T/FM-radio 'demodulator' chip, new designs combine it with the R820T digital tuner chip capable of handling radio frequencies between 24 and 1,850MHz and a unique DVB-T TV USB dongle is born. But when enthusiast Eric Fry discovers in 2010 that raw signal data from the chip can be tapped over USB, software-defined radio begins moving from an expensive enterprise to a task for a $20 USB dongle.

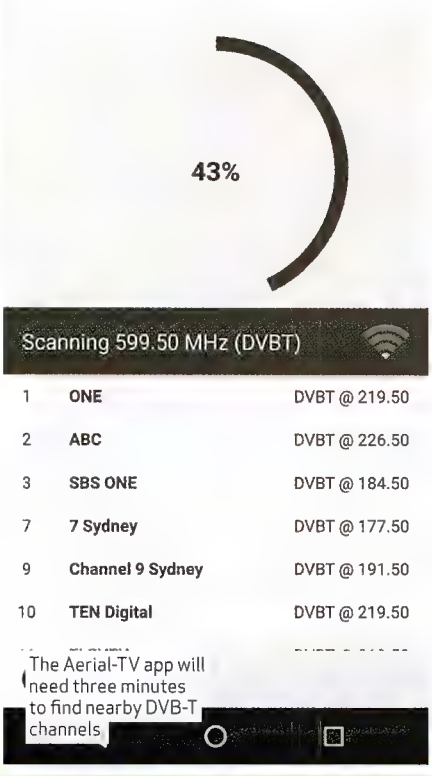
Now move that clock onto 2015 and the first driver software for the RTL2832U hits Google Play. Not long after, an app called SDRTouch lands, turning almost any Android device with a USB-OTG port into a software-defined radio capable of receiving frequency-modulated (FM), amplitude-modulated (AM), upper-sideband, lower-sideband (LSB) and continuous wave (CW) transmissions.

Motorola's Moto G5 with its USB-OTG had no trouble with SD DVB-TV.

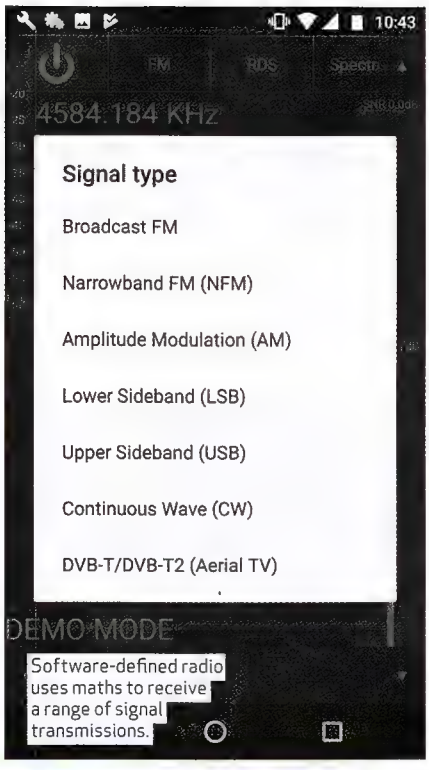
Samsung's Galaxy S8 should be able to play Full-HD DVB-T channels.

WHAT YOU CAN PICK UP

Having a radio in your pocket that can



The Aerial-TV app will need three minutes to find nearby DVB-T channels.



Software-defined radio uses maths to receive a range of signal transmissions.

> "Like most technology, SDR can also be applied to more nefarious purposes — it's been shown SDR can be used to hack into GSM mobile phone signals, an illegal act in virtually any country."

tune into any frequency from 24MHz to 1,850MHz covers a pretty decent chunk of the RF spectrum and with the ability to handle all of those transmission types, it means you can pick up everything from broadcast FM radio to digital TV.

You can even receive 'automatic dependent surveillance – broadcast' (ADS-B) signals transmitted by aircraft. These open and unencrypted signals are transmitted mostly at 1,090MHz and include flight details, location coordinates, plus altitude, rate-of-climb and other data. If you're one of the 10–50 million users who've tried the Flightradar24 app on Google Play (**tinyurl.com/npsgnay**), a good portion of the flight tracking data comes from other users with ADS-B receivers who share that data with Flightradar24. There are other ADS-B apps on Google Play that'll allow you to pick up these broadcasts directly from aircraft in your local vicinity using one of these dongles.

DON'T DO STUPID

But like most technology, SDR can also be applied to more nefarious purposes – for example, SDR has been shown to be used to hack into GSM mobile phone signals, an illegal act in virtually any country.

Essentially, the RTL2832U and R820T chips are receiving units only, so they don't need a licence in Australia – however, most USB dongles sold online and capable of SDR generally come with a warning to check the legality of listening to certain communications in your region, for example police or mobile phone transmissions. In the UK, you need a TV licence just to watch free-to-air TV, so in short, don't assume all countries have the same rules – they don't. And definitely don't do acts of stupidity.

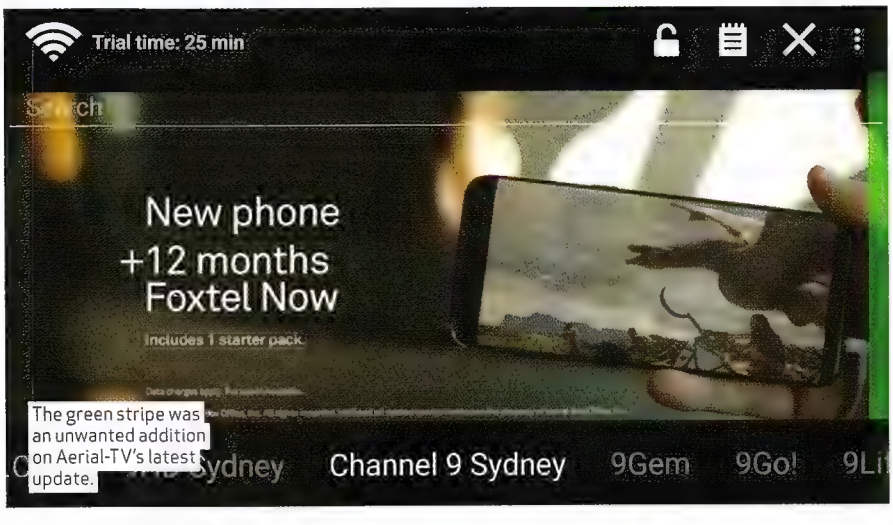
Meanwhile, SDR has become a global phenomenon, from a popular application for Raspberry Pi single-board computers through to the GNU Radio Project (**www.gnuradio.org**), the open-source software radio project supported by the Free Software Foundation and adopted by hobbyists, academics and business.

WHERE TO LEARN MORE

In fact, so popular has Realtek's RTL2832U chip become for SDR, there are websites dedicated to exploring this side of its capabilities. Aside from GNU Radio, RTL-SDR (**rtl-sdr.com**) is arguably one of the most detailed. As you can probably imagine, it's not just Android devices being turned into SDRs – apart from Raspberry Pi single-board computers, there are dozens of Windows, Linux and MacOS X apps available. Arguably the most popular Windows app is SDR# (pronounced 'SDR-sharp') from AirSpy (**airspy.com/download**, download the 'Windows SDR Software Package') and said to work with RTL2832U-based dongles. Most apps use the chip's ability to act as a radio-frequency spectrum analyser and offer a 'waterfall' spectrum display, showing transmission intensity in a frequency band over time.

THE DIGITAL DOMAIN

The fact that humans have managed to harness the analog world to transmit data without wires over unseen radio waves is still something to be amazed about more than 100 years after its invention. It's just as amazing as having a computer in your pocket that can play video, run almost any kind of app – or listen to those radio signals.

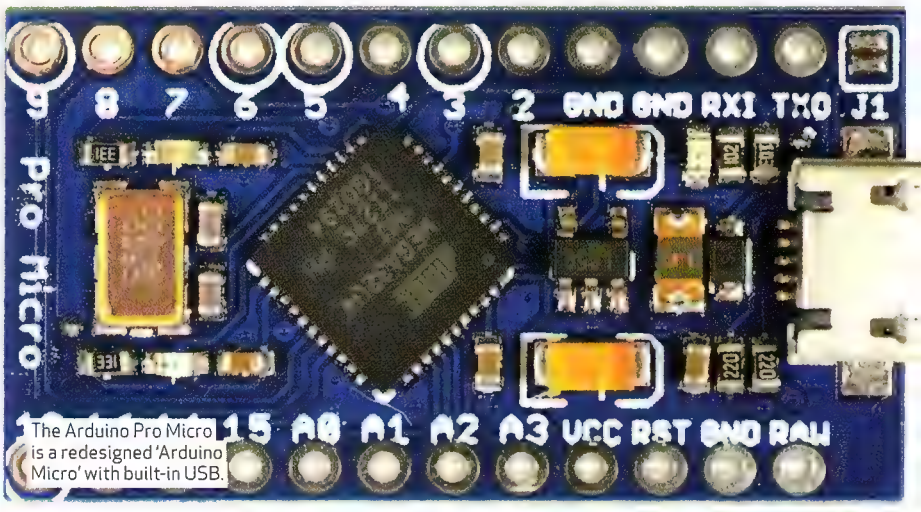


The green stripe was an unwanted addition on Aerial-TV's latest update.

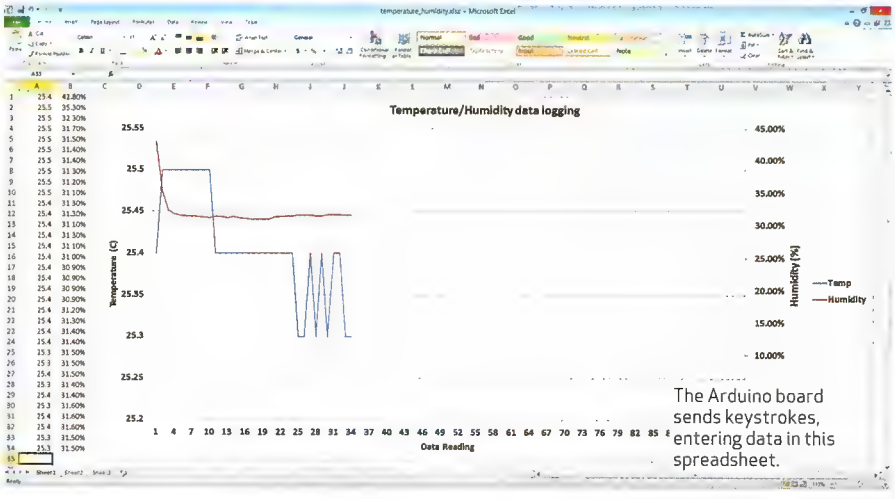
Automate your keyboard with Arduino

Sick of typing in the same key sequences? Replace your fingers with an Arduino Micro instead. Darren Yates explains how.

One of the most popular maker boards right now is the tiny Arduino Nano. About the price of a cup of coffee, we've been using it for much of the last year to build everything from digital audio recorders to oscilloscopes. But it's not the smallest Arduino – that title goes to the unofficial Arduino Pro Micro. It's a cut-down version of the Arduino Micro selling online for about two cups of coffee, but with one unique feature – it can emulate a PC keyboard or mouse.



The Arduino Pro Micro is a redesigned 'Arduino Micro' with built-in USB.



The Arduino board sends keystrokes, entering data in this spreadsheet.

ATMEGA32U4

While the Nano runs the standard ATMEGA328P microcontroller chip, the Pro Micro features the up-rated ATMEGA32u4. Apart from slightly more RAM, the ATMEGA32u4 has a built-in USB port – the ATMEGA328P inside most budget Nano boards relies on a fixed-function external USB chip called the CH340G for this. However, the benefit of having a built-in USB port is the ability to directly interact with USB host ports and emulate what's known as HID or 'human interface device' mode. In other words, you can make an Arduino Pro Micro behave like a mouse or a keyboard connected to your PC.

DATA LOGGING

Press a key on your keyboard, for example, 'D'. What you'll get is the letter 'D'. Keep holding it down and you get lots of 'D's. Press a button connected to your Arduino Pro Micro and you could get up to 30KB or so of text spilling into your current PC app via the USB port – even more if you connect up a MicroSD card module.

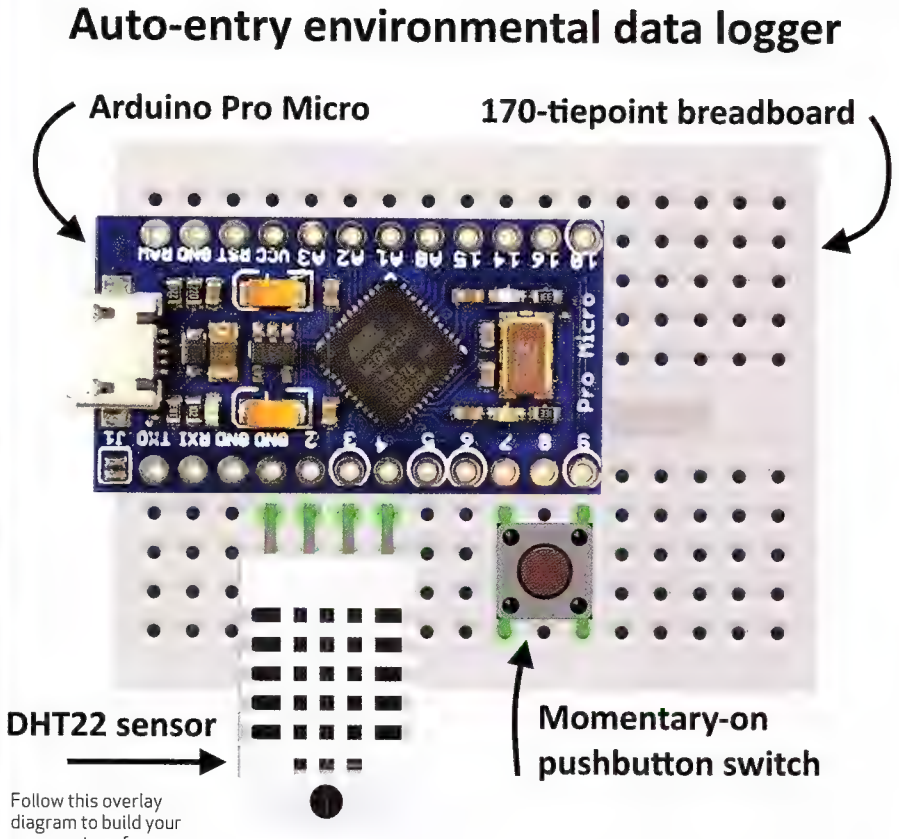
But another useful thing you can do is automate data entry. For example, you're capturing weather data using sensors connected to your Arduino board. The common thing to do is to save the data to a MicroSD card, which you later load up on your PC, or hook up a Wi-Fi module and send the data wirelessly to a remote service, such as Plotly (**www.plotly.com**). However, the other thing you could do is fire up a spreadsheet on your PC and have the Arduino board simply dump data directly into the spreadsheet – even save the spreadsheet automatically after each entry, all via direct USB connection.

HOW IT WORKS

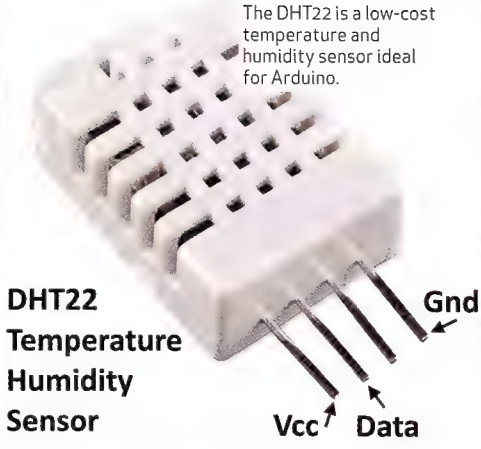
For this project, we're combining the Arduino Pro Micro board with our old friend, the DHT22 temperature/humidity sensor and a small momentary-on pushbutton switch. We're using the sensor just to provide some input, but the key is the Pro Micro's Keyboard library, which allows us to send temperature and humidity readings back to an Excel spreadsheet as keystrokes, where they'll be automatically entered, charted and saved to disk.

Why the pushbutton switch? The Arduino is coded to send out data as keystrokes at regular intervals using the SimpleTimer library, which triggers execution of a pre-determined user-coded function once the interval or delay period has passed. In our case, that function is the 'logData()' function – it takes the latest data from the DHT22 sensor and using the Keyboard.print() function, sends the data back to the PC as if it was typed on a standard keyboard.

Now here's the problem – after every interval, the Pro Micro board is sending keyboard keystrokes back up the USB cable, captured by which ever app has the current focus. Imagine



Follow this overlay diagram to build your own version of our data logger.



The DHT22 is a low-cost temperature and humidity sensor ideal for Arduino.

trying to edit your code in the Arduino IDE with the board connected and already loaded with code – those unwanted keyboard strokes will now appear in your source code, most likely causing syntax errors and stopping it from compiling. Without a data on-off switch to turn of these automated keystrokes, you'd be stuck with a board continuously mucking up your source code.

After you've flashed the board, it'll boot up with the yellow 'RX' LED off and data transmission disabled. Press the pushbutton switch, the LED comes on, indicating that the board is now sending data in 'keyboard' mode. Press it again and it stops sending.

The other thing you need to be aware of is that since the Keyboard library essentially takes over the keyboard input, you must 'play nice' and set your code to release all keys as soon as practical, otherwise, again, you're likely locking up the genuine keyboard.

SETTING UP YOUR SPREADSHEET

If you want your data to automatically enter into cells in the spreadsheet – and even update a chart – you must set it all up beforehand. That means you have a spreadsheet named and saved, with the cursor sitting on the top-left cell. The source code also assumes the spreadsheet app will have (and maintain) the focus.

When enabled via the pushbutton switch, the board begins sending temperature and humidity data as keystrokes to the first two columns of the spreadsheet. It does this through the Keyboard.print() and Keyboard.press() functions. After the temp data is added to the first cell, a right-arrow keypress is emulated, moving the cursor one cell to the right and here, the humidity data is 'printed'. Following that, the code presses the down-arrow key to drop down a row, then the left-arrow key to take the cursor back to the first column, ready for the next temperature reading. Before that next data arrives, the board sends the 'Ctrl-S' keypress combo to have the spreadsheet app save the file after each data entry and keeps this up until you run out of rows in your spreadsheet.

As for auto-creating the chart, the trick here is to insert the chart into the spreadsheet beforehand and linking, say, 100 rows or more of the first two columns to the plot area of that chart. This way, as data is added to each row, the chart automatically updates.

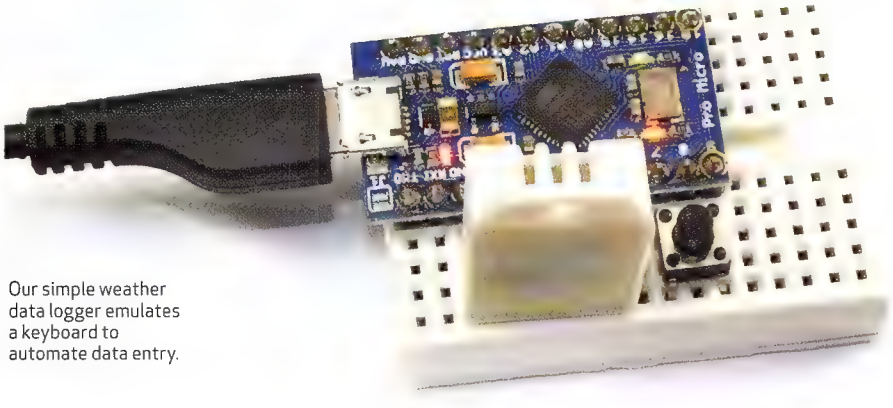
BUILDING THE DATA LOGGER

This project is about as easy to build as it gets – four components, including the breadboard. Follow the overlay diagram and you're done. You'll find the Arduino source code on our website at **apcmag.com/magstuff**. Download the zip file, unzip it and copy the contents of the /libraries subfolder into the same of your Arduino IDE. Restart the IDE for the additions to take effect. Load up the autologger.ino source code and flash it to the board (you'll need to choose 'Arduino Micro' as the board option).

Don't have Excel? Doesn't matter – remember, the Arduino is simply sending the data as keystrokes, so whichever app has the focus will capture those keystrokes. Whether that's Excel, Google Docs or whatever spreadsheet you like, that's up to you.

MAKING SOLUTIONS

The great thing about tech-making is being able to make your own solutions and there aren't too many employers these days who aren't impressed by good problem-solving skills!



Our simple weather data logger emulates a keyboard to automate data entry.

Stay classy with Python

Learn about object-oriented programming with Python as Darren Yates shows how to deal with classes.

Over the last year or so, we've looked at a whole range of different features that make up the Python programming language, from variables and if-conditional statements, to loops and functions. In fact, we've pretty much covered the basics for you to start confidently making your own Python apps. But to be in professional programming circles, you still need to have some computer science concepts under your belt and one of the biggies is 'object-oriented programming' or OOP. It's a way of thinking or 'paradigm' that permeates how you create programming solutions for problems – and as its name suggests, it's all about putting objects at the centre of your thinking.

THINKING IN OBJECTS

One of the great things about writing for *APC*, its sister magazine *TechLife* (and *PC User* before that) over the last 20 or so years is that I've got to play with, uh... *test* thousands of products, from desktop PCs and laptops, to CPUs and motherboards, tablets and phones. It's easy to make jokes about it, but testing products properly has to be a scientific, statistical and methodical process – especially when it comes to comparative reviews. For starters, if you're comparing products, it really helps that they actually be comparable – you can't very well compare a phone with a TV, or a CPU with a desktop computer. No doubt you know this intuitively and with our programmer's hat on, we'd say these products or 'objects' have to all be of the same type or 'class'. What's more, to compare these objects, you have to be able to compare their features or 'attributes'.

For example, the class of objects called 'smartphones' will all have the same basic attributes – they'll have a display, operating system, battery, processor SoC, RAM, built-in flash storage, camera, mobile network connection, Wi-Fi, Bluetooth and so on. Note, they won't have the same attribute values, but they will have the same basic set of attributes – for example, the 'iPhone 8' object has the value 'iOS 11' for its 'operating system' attribute, while the 'Galaxy Note 8' object has 'Android 7.1.2'.

In fact, this highlights an important point to remember – objects and attributes can be physical or abstract, for example, the 'smartphone' object is real, but 'operating system' is an abstract concept (you can't hold an OS).

One reason why testing products is often statistical is when comparing the performance of products like laptops or CPUs, motherboards or graphics cards. A key buying point with these products is speed, so here, benchmark test results become new, extra attributes. For example, with our 'smartphone' objects, battery life is a key attribute, so too gaming performance on key games, not to mention the attribute that ultimately rules, 'price'.

Even when you go shopping, you inherently know to compare the different attributes of products – on a phone, you'll compare price, screen size, the size of the battery, you may even compare the version of operating system on-board, then make a judgement on which phone you think is better. You could even try doing this mathematically...

WHAT'S THIS GOT TO DO WITH CODING?

What we've been doing is the essence of object-oriented programming – if we've been tasked with the job of writing an app involving smartphones, OOP says (as do most good coding paradigms) that you start by analysing your area or 'domain' (in this case, smartphones) to understand what's required of a solution. With OOP, that begins with objects – and the way you characterise or 'model' objects in Python is with the 'Class' structure.

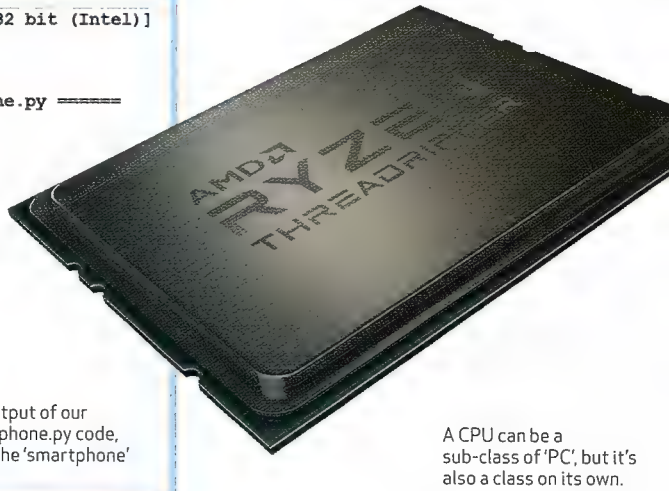
'SMARTPHONE' CLASS

Because OOP is the paradigm followed in most programming circles, you'll find it's supported by major programming languages, from C# to Java – and it's also supported in Python (another reason why Python is one of the world's top-five programming languages).

The way Python allows us to create a 'smartphone' object is through the 'Class' structure. It describes the features and functions that apply to the 'smartphone' class and acts as a template, meaning it allows us to quickly and easily create multiple copies or 'instances' of itself. Instead of having to create multiple variables to store the attribute values of different smartphones for example, we can create a new instance of the

```
Python 3.6.1 Shell
File Edit Shell Debug Options Window Help
Python 3.6.1 (v3.6.1:69c0db5, Mar 21 2017, 17:54:52) [MSC v.1900 32 bit (Intel)]
 on win32
Type "copyright", "credits" or "license()" for more information.
>>>
====== RESTART: C:/Users/Darren/Python Code/Python_EP_17/smartphone.py ======

--- Smartphone Class Review Score Calculator ---

Enter the smartphone model name : APC SkyTalker
Enter screen size (inches)      : 6.5
Enter the operating system      : TalkOS
Enter battery capacity in mAh   : 2700
Enter the CPU core count        : 6

Your phone model name           : APC SkyTalker
Your phone screen size          : 6.5 inches
Your phone operating system     : TalkOS
Your phone battery capacity     : 2700.0 mAh
Your phone CPU core count       : 6

Buyers score (out of 10)        : 8.595238095238095
>>>
Ln: 21  Col: 4
```

The output of our Smartphone.py code, using the 'smartphone' class.



A CPU can be a sub-class of 'PC', but it's also a class on its own.

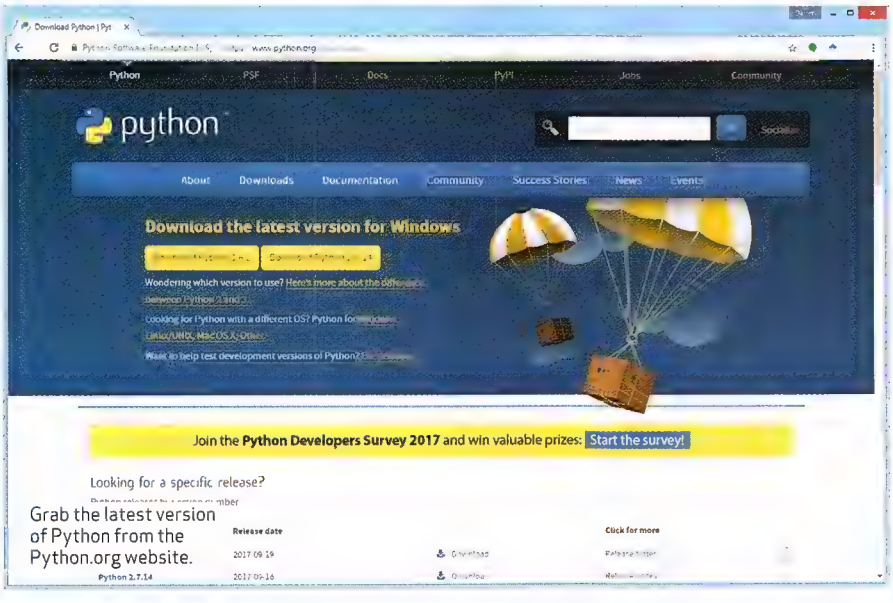
```
*smartphone.py - C:/Users/Darren/Python Code/Python_EP_17/smartphone.py (3.6.1)*
File Edit Format Run Options Window Help
class Smartphone:

    def __init__(self, name, size, os, bat, cores):
        self.__name = name
        self.__screenSize = size
        self.__operatingSystem = os
        self.__batteryCapacity = bat
        self.__cpuCores = cores
        self.__rating = 0

    def get_name(self):
        return self.__name

    def get_screensize(self):
        return self.__screenSize

    def get_operatingsystem(self):
        return self.__operatingSystem

    def get_batterycapacity(self):
        return self.__batteryCapacity

    def get_cpucores(self):
        return self.__cpuCores

    def get_rating(self):
        rating = (self.__screenSize / 7.0) + \
                 (self.__batteryCapacity / 3000.0) + \
                 (self.__cpuCores / 8.0)
        self.__rating = (rating / 3.0) * 10.0
        if (self.__rating > 10.0):
            self.__rating = 10.0
        return self.__rating

def main():
Ln: 35 Col: 11
```

Our 'smartphone' class with its own attributes and functions.

Laptops are a superclass with many subclasses of components, including CPU.

```
*smartphone.py - C:/Users/Darren/Python Code/Python_EP_17/smartphone.py (3.6.1)*
File Edit Format Run Options Window Help
        return self.__rating

def main():

    print("\n--- Smartphone Class Review Score Calculator ---")
    name = input("\nEnter the smartphone model name : ")
    size = float(input("Enter screen size (inches)       : "))
    os = input("Enter the operating system       : ")
    bat = float(input("Enter battery capacity in mAh    : "))
    cores = int(input("Enter the CPU core count         : "))

    newPhone = Smartphone(name, size, os, bat, cores)

    print('\nYour phone model name           :', newPhone.get_name())
    print('Your phone screen size          :', newPhone.get_screensize(), 'inches')
    print('Your phone operating system     :', newPhone.get_operatingsystem())
    print('Your phone battery capacity     :', newPhone.get_batterycapacity(), 'mAh')
    print('Your phone CPU core count       :', newPhone.get_cpucores())
    print('\nRating score (out of 10)        :', newPhone.get_rating())

main()
Ln: 53 Col: 14
```

The main() function in our code creates an instance of the 'smartphone' class.



Grab the latest version of Python from the Python.org website.

'smartphone' class and all of those attribute variables, such as screen size or battery capacity are created automatically, ready to populate.

CLASS DEFINITION

However, for the 'smartphone' cookie-cutter to be able to stamp out smartphone instances, we first have to define what that 'smartphone' class is. Grab this month's Python source pack from the *APC* website (**www.apcmag.com/magstuff**), unzip it and open up 'smartphone.py' in the Python IDLE editor. You'll notice the very first thing we do is create the smartphone class and define how it works. The definition comes in the form of a number of internal functions, shown by the 'def' code. The very first of these is the initialisation ('__init__') function. It runs automatically when you create an instance of the smartphone class. It's the place where we set up the attributes the class takes – in our case, these are the name of the smartphone (__name), screen size (__screenSize), operating system (__operatingSystem), battery capacity (__batteryCapacity), number of CPU cores (__cpuCores) and the rating (__rating). The first five of these attribute variables get their values from the parameters in the __init__ code line, while the last variable, 'rating', is set to zero (we'll see how this all works in practice in a moment).

The reason for all the double underscores (__) at the beginning of each variable here is this is Python's way of hiding them, so they can't be accessed outside of the class code. This is important because you want to be able to control how external code accesses these variables, otherwise errors or other unwanted problems could be introduced.

The other thing you've probably noticed is the continual reference to 'self' – no, it's not latent narcissism, 'self' is the term used to indicate these variables belong

Completely different, but both belong to the class called 'smartphone'.

to or are attached to each instance of this class (if that doesn't quite make sense yet, don't worry – we'll get there shortly).

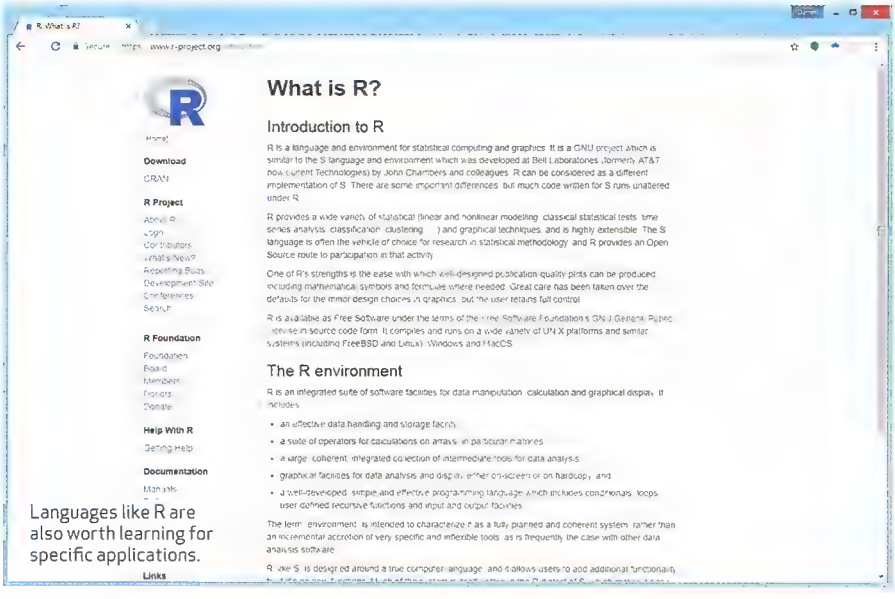
GETTERS

In order to get access to these hidden internal variables, we create what are colloquially called 'getter' functions that return these values in a more structured way. The next five class functions: get_name(), get_screensize(), get_operatingsystem(), get_cpucores() and get_batterycapacity() simply return the value of their respective internal variables. The external code that calls these functions knows nothing about the internal variables, it only receives the values the class wants them to get.

For example, you may have an internal transaction code added each time a class instance is used – that's probably not something you'll want external code having access to.

SETTERS

If you're going to lock-down access to your internal variables and require them be read using getter functions, you'll also likely need some way of allowing external code to modify those values. That's where 'setter' functions come in. The difference between 'getters' and 'setters' is that setter functions require at least one parameter, containing the value or references to the value you want to write to your hidden internal variable.



Languages like R are also worth learning for specific applications.

Then it's just a matter of writing the value to the internal variable and you're done. It sounds messy, but it is a clean way of keeping track of where your internal variables are being used.

CLASS FUNCTIONS

So far, we've talked exclusively about classes and their attributes. Even the getter and setter functions are just about attributes. However, functions can also perform actual tasks and here's where we use the 'rating' variable. Remember us discussing about mathematically rating smartphones based on their attribute values? There's a very simple function called get_rating(), which crudely attempts to calculate a rating out of 10, based on the numeric values of key attributes.

It takes the screen size of the phone and divides it by 7.0, adds it to the battery capacity divided by 3,000.0 and further adds the cpuCore count divided by 8. The result is stored in the variable 'rating', which is then divided by 3.0, multiplied by 10.0 and stored in the '__rating' variable. Then if the value of '__rating' is greater than 10.0, it's set to 10.0. Finally, the function returns this value.

USING THE CLASS

Our 'smartphone.py' app is an app in two halves – this first half sets up the smartphone class, now we look at how to use the class through the main() function.

Have a look at the main() function and you'll see that it's only 13 lines of code – six ask the user for input and another six print data back to the user. That leaves just one line of code that does something interesting – and that's this line:

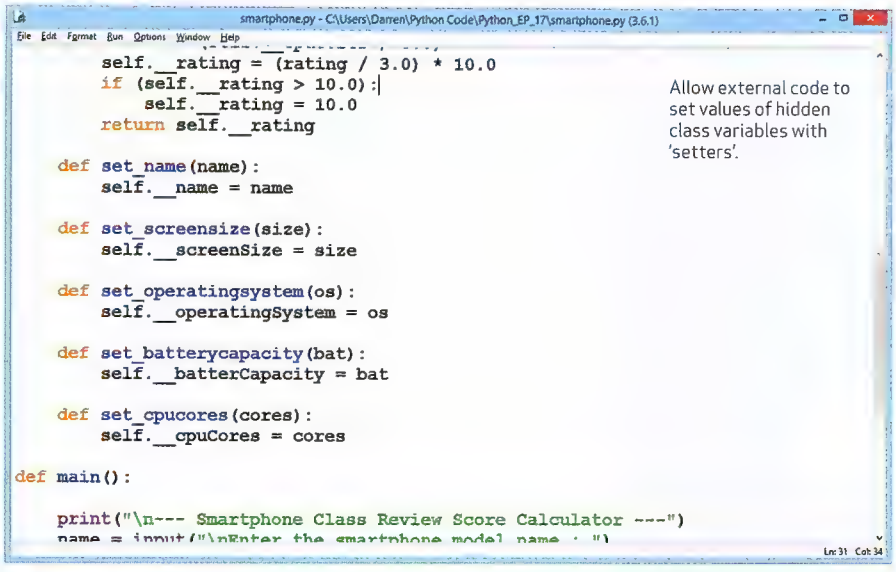
```
newPhone = Smartphone(name, size, os, bat, cores)
```

With this one line of code, we create an instance called 'newPhone' of the 'Smartphone' class and we load up the internal attributes with the values of the parameters 'name', 'size', 'os', 'bat' and 'cores'. Remember, when creating the 'newPhone' instance, the '__init__' function launches automatically, grabbing these values from the parameter list and loading them into the appropriate values. How do we get the right value to the right attribute variable? The order of the parameter list must match the order of the variables as they appear in the '__init__' function.

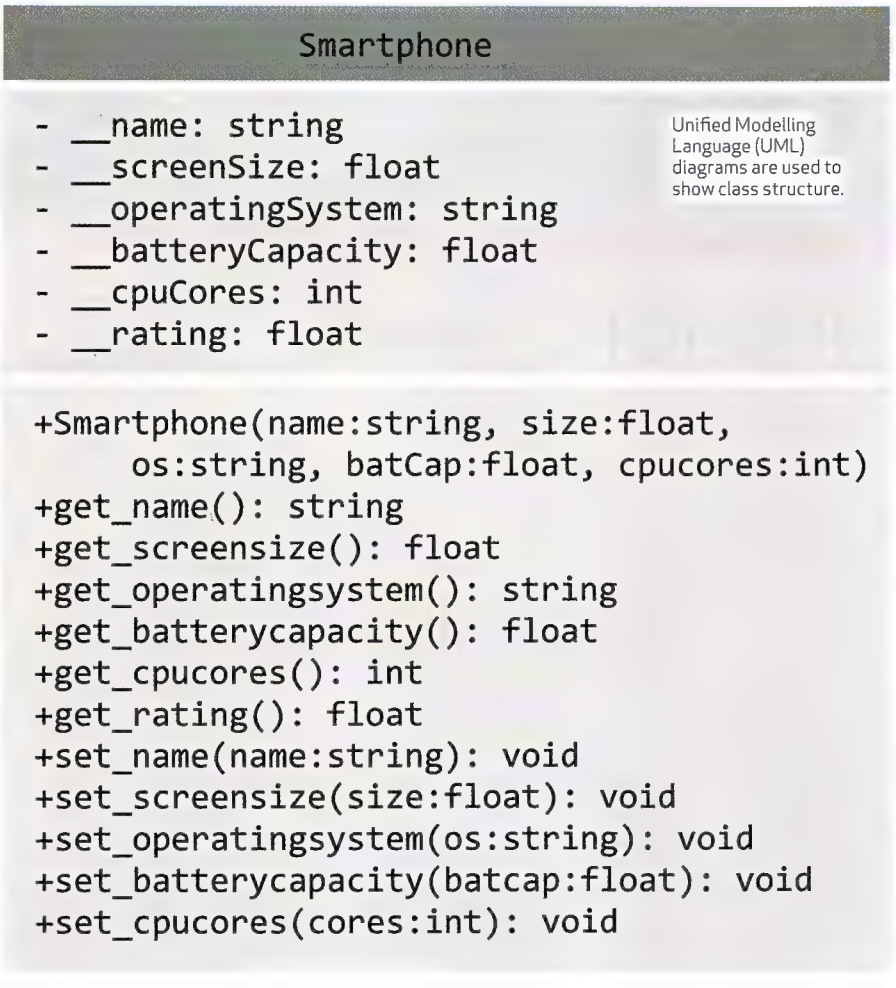
The six print() statements start with text describing the attribute, followed by the attribute called from the appropriate getter function, again, for example,

```
print('Your phone battery capacity     :', newPhone.get_batterycapacity(), 'mAh')
```

Here, we're calling get_batterycapacity() to return the battery capacity rating. The last print() function calls the get_rating() function and it's only now that the rating



Allow external code to set values of hidden class variables with 'setters'.



Unified Modelling Language (UML) diagrams are used to show class structure.

score is calculated and returned to the print() function and displayed on screen.

UNIFIED MODELLING LANGUAGE

The task of developing a class that describes an object is often called 'Systems Analysis' and it's a science on its own. Invariably, it involves talking to relevant stakeholders (users and programmers) about what an app might need. To make them more easily understood, classes are often drawn using what's known as UML or 'unified modelling language' diagrams, grouped by class title, attributes and functions in that order.

In other languages where variables must be declared and initialised before use, UML diagrams will include that information as well – we've shown them in our Smartphone UML diagram as integer (int), floating-point (float) and string variables for completeness, but remember Python selects the type automatically. The '+' and '–' show whether an attribute or function is (+) or is not (-) visible or 'public' outside the class.

MORE ADVANCED CONCEPTS

Classes are now so fundamental to modern programming that more advanced concepts such as 'polymorphism' and 'inheritance' are built around them. If you can get your head around these two ideas, you've taken a massive step forward in understanding the theory behind modern computer apps.

We'll look more at these next time, but just briefly, inheritance works much like it does in real life – we each inherit physical attributes from our parents and in programming, you can create a 'subclass' that inherits the attributes and functions from its 'parent' or 'super' class. You can even build on or 'extend' them.

Meanwhile, polymorphism is the ability to overrule or 'override' a class function with a different function of the same name and use in different situations, a feature that becomes important when combined with inheritance.

THE SECRET TO PROGRAMMING

I reckon the secret of programming comes down to one phrase – 'life-long learning'. These days, you can't afford to think one programming language will cover every situation you'll come up against – some languages or paradigms will suit some applications better than others.

With the end of car manufacturing in Australia this year, the tribal wars fought over 'Ford vs Holden' will inevitably have less impact in years to come. But you still find this tribalism in programming with staunch supporters of Java, others who consider C# the best language around and yet more still who are fans of Python or Swift or even COBOL and BASIC.

One question often asked is whether you should concentrate on just one language and get really good at it, or spread yourself over several, enough to be at least competent to use them. Everyone seems to have their own preference, but if it's about finding a job, look at programming roles available on Seek and notice the languages employers in your field are looking for. Even for similar roles, some employers will want Java, others Python, others, again, R or SPSS.

In recent times, most lists of 'top-five in-demand programming languages' have invariably included (in no particular order) Java, Python and C#. Nailing down any of these as a base, then adding one or more specialised languages to suit your field, such as R or SQL or PHP or Javascript, shouldn't do your employment prospects any harm at all. ■

downtimegames

» EDITED BY CARMEL SEALEY

Forzavista now extends to the pit lane at the start of a race for you to oggle your car.

PC, XO | $99.95 | FORZAMOTORSPORT.NET

Forza Motorsport 7

Revved up and on track for a podium finish.

Turn 10 knows what its audience wants: more of the same, but better, and the studio has largely delivered with *Forza Motorsport 7*.

Car handling has been tweaked ever so slightly since 2015. That glorious weight is still there, but feels more responsive than before, feedback through the controller amplified by better, more violent sound design and visuals that communicate the drama of metal-on-metal.

Leaning more towards the simulation side than the loose and forgiving arcade, you can really dial it up with a wheel, but no one else does tactile pad controls like Turn 10. When it all goes pear-shaped, crashes have the power to shock and clipping a tyre barrier sends stacked treads flying. It can all be undone with the rewind button, though it's worth sticking around until the sound of tinkling glass has faded, and to gawp at the loose panels and worrying dents in your car's bodywork.

After an introduction that will have old hands scrambling to turn off the hand-holding safety assists, it's all-go in a campaign that offers more freedom than any other *Motorsport*. The main campaign, the Forza Drivers Cup, works as a series within a larger series, and you're free to choose from a menu of races across different disciplines, as well as showcase events.

Rewards pile on pretty quickly in the early stages. Races earn credits and XP, showcases gift a car, and you'll have to level up to gain access to new tiers of motors. It's frustrating at first, though after a few hours, you'll have your fingertips on the top of Tier 5 (there are eight all up). However, lots of vehicles are also tucked away in a specialty dealer whose stock rotates every 10 days, as well as timed Forzathon events, and in loot crates. The differing levels of crates also have mod cards and gear for your driver, so there's no clear way to know exactly when you're going to get your hands on the beastly '95 Nismo GT-R LM, or spine-breaking Ford RS200. That's three barriers to getting your mitts on the machine that you want, rather than simply forking out the required credits.

Focus on the racing, though, and the game shines – it is unequivocally the best-looking and best-sounding racing game you can get for your Xbox right now. On an Xbox One X, running at 4K, it's sell-your-own-mother material. With a field of 24 cars jostling for position, it's both a visual and aural spectacle. Weather effects will make you dribble. However, not every track gets the joy of having its tarmac covered in the wet stuff. We'd love to see Australia's Bathurst come alive from dawn and sink into the sunset, alas it'll always be dry but overcast on Mount Panorama.

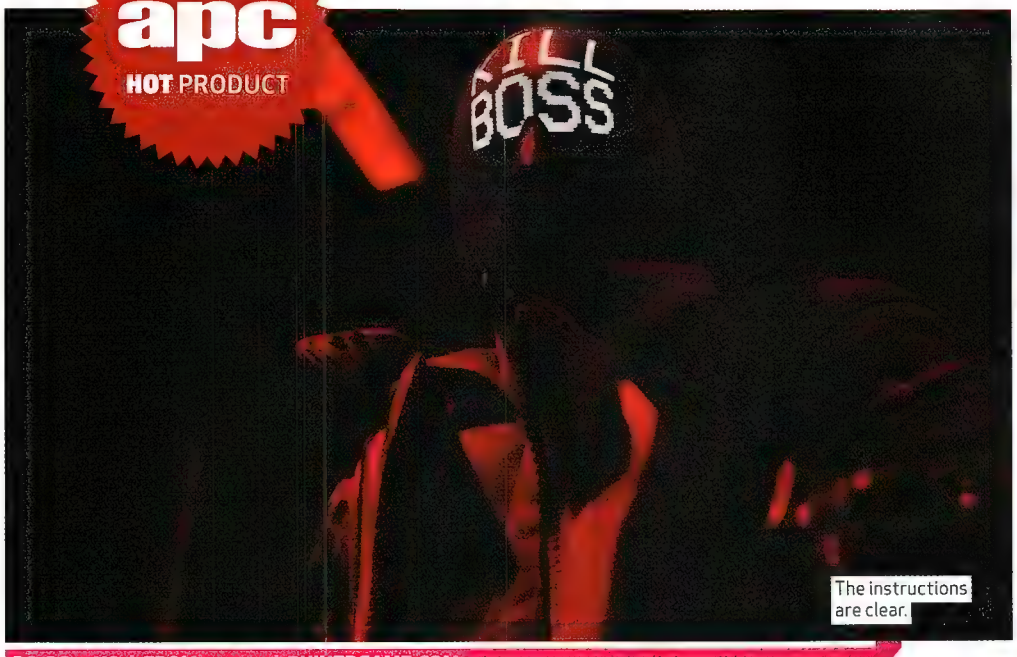
What a year it's been for racing games. For anyone who's taken a break from *Forza Motorsport* for a few sequels, they'll see a game that eclipses all other track racers. Long-term fans will see the improvements, but likely feel held back by the perverse reward structure.

Sure, frustrations from *Motorsport 6* have been eradicated, but it's a pity they've been replaced by new ones. ■ **Paul Taylor**

Verdict

Putting aside the rewards system snafu, a must-play drop-dead gorgeous racer.

★★★★½



The instructions are clear.

PC, PS4, XO | FROM $24.95 | RUINERGAME.COM

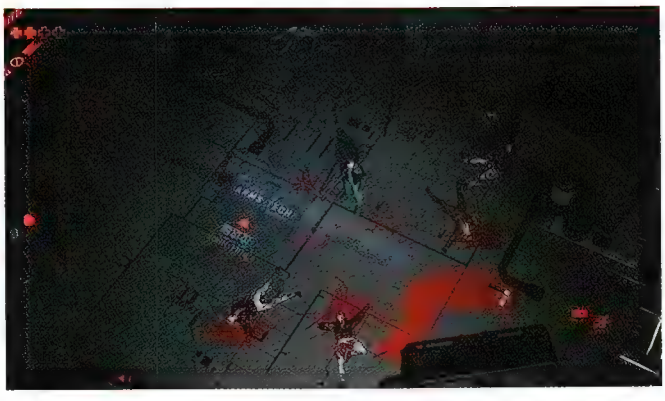
Ruiner

Grungy streets, hackable mainframes and ethical ambiguity.

If you got a kick out of games like *Hotline Miami* or *Hyper Light Drifter*, prepare to meet their cyberpunk-obsessed teenage son. *Ruiner* is isometric, violent and unapologetically drenched in the neo-noir aesthetic found in '80s classics like *Blade Runner*. The hint of cel-shading in the art brings to life the graphic-novel grit of the environment, and the grungy, industrial soundtrack enhances that setting without relying on tropes.

With a combination of a melee and ranged weapons at hand, you're given your first objective – KILL BOSS – indicative of the arcade action that forms the core of the game. *Ruiner* spends most of its time testing your mettle in unrelenting combat.

While the action is fast-paced, it requires healthy doses of both strategy and fast reflexes, as you chain together different skills and attacks. Thankfully, you don't have to settle on a single play-style; you're able to reset and redistribute character points to favour



differing abilities – like shields and dodging or weapon buffs and grenades – at will. This allows you to try out life as a havoc-wreaking tank or a nimble assassin in a single playthrough, although the finesse required to execute these moves makes the assignment of character points a necessity rather than a luxury.

The hubs offer more than just respite from the action, they provide a surprisingly fleshed-out glimpse into the dynamic world of Rengkok and its seedy underbelly. You'll meet plenty of quirky characters that will inadvertently tell you what life is like in 2091, such as the Disorder Nun who will offer you some skill-points (called 'Karma' in this universe) in exchange for your salvation through pain (aka, repeated deaths while on-mission, which you'll have no trouble accruing).

Ruiner is rich, rewarding, and punishing if you want it to be, but for lovers of the setting and the style, this is a compelling concoction that deftly straddles the line between pleasure and pain.

■ Harry Domanski

Verdict

Not just for the diehard cyberpunks – there's enough chaotic joy to be had to convert any player into genre-fans.

★★★★½

Cuphead

Cup runneth sideways.

XO, PC | $29.95

CUPHEADGAME.COM

Devilishly difficult and crafted with an immaculate level of detail, *Cuphead* is a special type of platformer — a shoot'em-up that will have you tearing your hair out in frustration only to come back for more. With its beautiful, hand-drawn animation and astonishing Max Fleischer-inspired art-style, *Cuphead* feels like an interactive 1930s cartoon — it's scored with a note-perfect mix of ragtime, jazz and big band music, complementing the game's fuzzy, distant sound effects magnificently. Together, these elements absolutely nail the old-timey aesthetic of the *Betty Boop* and *Popeye* cartoons that inspired it. Levels are comprised of traditional platforming sections and boss fights, with the balance skewed more towards the latter. Occasionally, a vehicular section will arrive to break things up, but you'll spend the most time learning boss attack patterns. Thankfully, you can use gold collected during levels to purchase upgrades for your character, such as new weapons (we're partial to the heat-seeking Chaser gun), extra health points and special abilities. Built for 1–2 players, *Cuphead* is short, tough and endlessly replayable.

■ Stephen Lambrechts

★★★★½

Dishonored 2: Death of the Outsider

As finishing chapters go, you Karnac' it...!

PC, PS4, XO | $39.95
DISHONORED.BETHESDA.NET

Another minor character gets their own stand-alone game to finish a big series? It's a welcome trend, and *Death Of The Outsider* aptly ties up Arkane's murky world of assassinations. Vengeance is a running theme in *Dishonored*, and that's still the case here as your one last job is to kill the Outsider, the black-eyed figure responsible for most of the series' events. So it's a surprise to find that most of it plays out more like a heist with different entry routes and methods. *Dishonored* is all about giving you options. Billie can Displace, which lets you set up a spot to warp back to as long as it's in your line of sight. Foresight lets your out-of-body self explore to mark enemies and items. While the choices are intoxicating, combat still isn't *Dishonored*'s best suit. Don't let every guard rush you down — if you're going to be violent, put the knife in before anyone's any the wiser. There are also some welcome changes. Your mana gauge now gradually regenerates, and the morality system has been done away with. While there's nothing to rival the Clockwork Mansion, its story is well told. Billie is also a more compelling protagonist, with some great wry observations. *Death Of The Outsider* is a satisfying conclusion to the story that began five years ago, and well worth revisiting. ■ Alan Wen

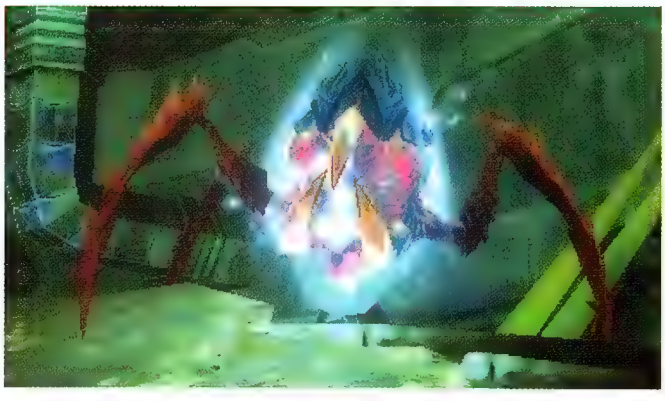
3DS | $60 | METROIDSAMUSRETURNS.NINTENDO.COM

Metroid: Samus Returns

Nintendo takes its sci-fi series back to its roots.

It's been over 10 years — an age in video game time — since the last 2D *Metroid* game was released, but this reimagining of the series' second entry (which originally appeared on the Game Boy way back in 1991) was well worth the wait. And while it closely follows the classic Metroidvania gameplay template, *Samus Returns* incorporates enough new gameplay ideas to make it feel fresher than most imitators.

Key among those is a new counterattack capability, which, if timed right, lets you quickly take down attackers by temporarily stunning and auto-aiming your weapon at them. It makes most enemy encounters faster than in previous 2D series entries, and combined with full 360° aiming (rather than at 45° increments) and some of the best graphics on the Nintendo 3DS we've seen, it really speeds up the game's overall pace and makes the action feel far more organic.



Like the 1991 original, this new remake is very light on story however.

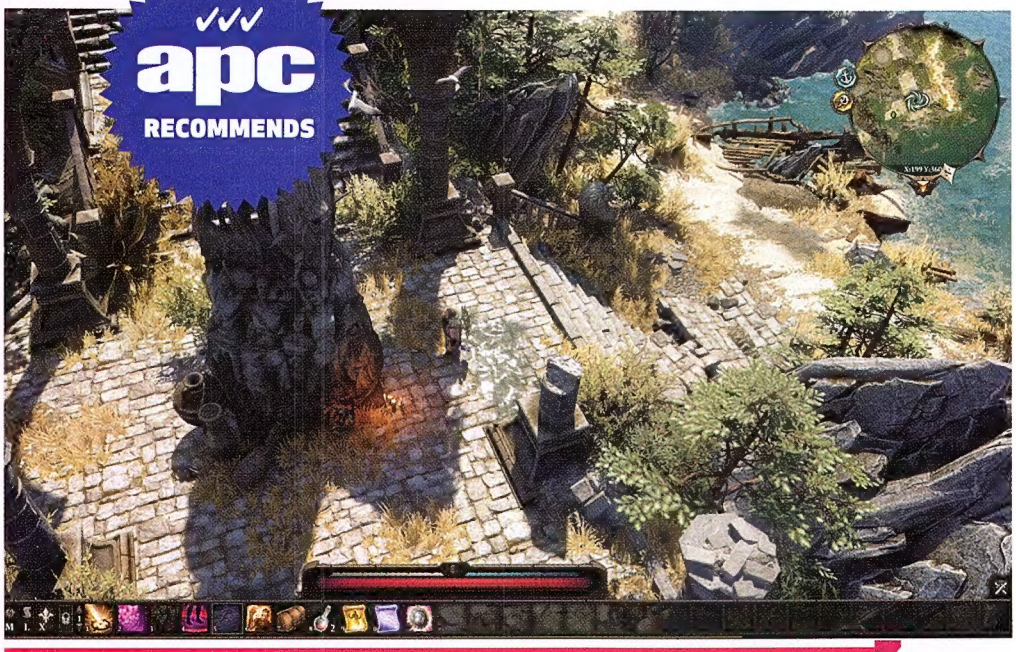
Playing as series protagonist Samus Aran, you're sent to investigate the Metroids' home planet of SR388, and for most of the game's length, there's basically no dialog or other characters, with the focus squarely on exploring, acquiring weapons and power-ups to unlock new areas and, of course, shooting lots of Metroids.

In fact, *Samus Returns* really revolves around a collection of 40-odd Metroid miniboss and boss battles, where typically you'll need to learn the enemy attack pattern, figure out how to avoid it (typically by jumping, crouching, running or hanging off a ledge) and landing a few attacks of your own in-between.

It adds up to a *Metroid* game that feels like one of the best-balanced entires in the entire series — and one that amply shows there's still room for new ideas in the Metroidvania formula. ■ Dan Gardiner

Verdict

A glorious return to the series' 2D roots, with well-executed new elements that help keep it feeling fresh.



PC | US$45 | DIVINITY.GAME

Divinity: Original Sin 2

The gods are dead; the world is yours.

Hmm, a sequel to a prequel – there should be a word for that... Kickstarted to the tune of around $2 million, *Original Sin 2* is epic in both scope and storyline. It's linear yet open – you can kill anyone, trade with anyone, talk to anyone – and following the success of the previous game in the series, has a lot to live up to.

This is a thoughtful, sprawling update of the sort-of-isometric RPG. The very beginning screams *Planescape: Torment*, as your protagonist wakes up on a table in a steampunky laboratory, and it goes on to echo Black Isle's Infinity Engine games as you explore cities and recruit party members, and *The Elder Scrolls* with its tale of a prisoner becoming some sort of chosen one.

Creating your character is the first order of business, and dev Larian has served up several pre-made avatars with origin stories, motivations and dialogue options. If you want to roll your own, you still can, but the ready baked ones are a good place to start. The character creator does a good job of explaining the various races and classes, and there's a nice find in the language used to describe your gender, adding that this is the gender others will perceive you to be.

We choose the Red Prince initially, as we've always fancied being a 10ft, fire-breathing lizard in a turban. His dialogue largely involves slapping down any proles who dare look at him, which doesn't make for the most charming party leader, and the inherent anti-lizard bias of many NPCs we encounter can drive prices up in shops and deny him help from (un)friendly locals. Balancing him out with some more charismatic party members who can take the lead in negotiations gets us out of a few fights.

Picking up party members couldn't be simpler. A brief conversation about what your party needs collapses their waveform into that precise niche. So you can ask a magic user to be a damage dealer or a healer, or even to be sneaky thief.

Combat is turn-based, and one of the game's weaker features – it's too easy to get bunched up, easy prey to any area-of-effect spells, and as each party member has limited action points to spend on his or her turn, you don't want to waste them by walking. You'll quicksave a lot, can retreat from combat, and difficulty is handled well, with an Explorer level that allows you to progress through the story without having to worry too much about combat difficulty.

It's in the nature of long games such as this to be a little slow, and the initial areas of a sinking ship and a prison fort are just that, especially if you sit back and soak up every line of dialogue. Escape from the jail, especially if you can get your Source-damping collar removed in the process, and the game becomes one of skeletons, dragons, spells and revenge.

With just a slight increase in the pace, it'll make *OS2* players more likely to stick around and see the fine sights on offer. ■ Ian Evenden

Verdict

There's so much life in the RPG genre, and *Original Sin 2* absolutely crackles with its energy.

★★★★☆

Project Cars 2

For the fast and the curious.

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PROJECTCARSGAME.COM

Any misgivings you had about *Project Cars* — its twitchy handling and lack of personality — should be thrown out in the pits with this sequel. *Project Cars 2* is far more approachable with a controller, and when you get to a point where you dare race in anything but blazing sunshine on a clear day, it shows off what it's really capable of. In fact, you're wasting your time if you don't experiment with the weather and time settings. Nothing else comes close to showing off how rain and snow, and even the position of the sun, can really meddle with your race plans.

The car selection, tracklist and race types are astounding. Road racing, circuits, utterly astonishing ice tracks and rallycross are all here. Over 180 cars from karts to F1, and more than 190 circuit layouts that span the globe. Only *Forza Motorsport* dares to come close on numbers. Cars can be tweaked and tuned as much as you'd like, and while an degree in mechanics would serve you well, a race engineer poses simple questions to help you modify the car to how you want it to be. Anyone who wants a challenge, to race and really appreciate the way vehicles handle and respond in mixed motorsports, should look no further. Devoid of gimmicks, *Project Cars 2* is intimidatingly deep but offers more than most racing games pretend to. ■ Paul Taylor

★★★★☆

Mattel's Aristotle no longer your kids' 'plastic pal'

Toy company cancels its kid-focused IoT device.

CES 2017 revealed a number of questionable technologies, including the Hushme voice mask, a pair of vibrating shorts, a judgemental hairbrush and DockATot Deluxe – a crib that nudges your baby... (See issue 438, page 16 for more.) It also featured Mattel's smart speaker Aristotle, a voice-activated companion for your child that can sing lullabies to babies, automatically order nappies when you're running out, look for baby supplies deals online, read your children stories and help kids with their homework. It also comes with a wireless camera to handily send footage of your darlings to your phone. Strangely enough, parents (and the wider community) thought this sounded like a disaster waiting to happen, particularly in the age of IoT security worries. Many also raised doubts about the necessity of children growing up with an AI to answer all their questions rather than a parent. Mattel has evidently taken the hint and cancelled its plans to release the bedroom-dwelling device, citing that the product didn't fit in to their "new technology strategy".

First colours, then towns... now it's beer

THE AI NAMING YOUR FAVOURITE CRAFT BEERS.

Research scientist Janelle Shane has a history of teaching her neural network to name things – including kittens (Jexley Pickle and Tilly Mapper), metal bands (Deathcrack and Sespessstion Sanicilevus) and Pokémon (Staroptor with the power of Stench). This time around, however, she set it to work naming beers. Using a dataset including 90 different types of beer, Janelle was able to come up with some passable names, including Heaven Cat, Flying Rocks IPA, Gate Rooster, Single Horde and Pimperdiginistic The Blacksmith. [*Wouldn't mind a nice cold Rickin Organic Red Deaath, myself. – Ed*]
Well, Old Nation Brewing from Michigan in the US approached Janelle and her AI to name their latest beer. After a lot of syphoning, the neural network offered 'The Fine Stranger', which was happily adopted.

Game, set and match

THE ROBOT THAT WANTS TO MAKE YOU BETTER AT TABLE TENNIS.

The Guinness World Records will soon have its hands full handing out 'First Robot to...' awards, if this column is anything to go by. FORPHEUS is the award-winning table tennis tutor that wants to "draw out human capability". While that might sound a bit like torture, the Omron Corporation insists that the robot can analyse its opponent's skill and play against them to match that level, ensuring that rallies can be thoroughly enjoyed by all. And since its last version, FORPHEUS has had an upgrade. Where once advanced players had utilised aces and smashes to their advantage (as their robot opponent could not react fast enough), FORPHEUS now has the ability to deal with smashes of up to 80km/h! Blimey.

Zume! Zume!

THE CALIFORNIAN BUSINESS SERVING AI-MADE PIZZAS.

Pepe, Giorgio, Marta, Bruno and Doughbot (he got the short straw at the naming stage...) aren't your average employees. No. These workers are, you guessed it, robots. Working as a team, Doughbot takes the dough ball and squishes it into the desirable shape, Pepe and Giorgio apply tomato or alfredo sauces to the base, Marta then smooshes that sauce around. The conveyor belt takes the pizzas to the human workers to apply the toppings (the company's co-founder explains that humans are just better at this bit), then the pizzas make their way to Bruno who pops them in the oven. We wonder whether Walter White would've thrown one of these robot-made pizzas on his roof... ■

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